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ABSTRACT

These conference proceedings deal with an interdisciplinary approach to reducing handicapping conditions and ensuring integration of and equal participation by people with disabilities in all aspects of community life. Papers from plenary sessions cover such topics as psychological and social aspects of rehabilitation, research methodology in special education, the role of randomized trials, medicolegal assessment of residual disability and employment handicap, trends in the adjustment of disabled people to the marketplace, etc. In addition, papers from working groups cover the following areas: "Critical Evaluation of Functional Improvements in Respect of Mobility, Manual Dexterity, Activities of Daily Living," "Use of Prostheses, Orthoses, and Technical Aids," "Stroke," "Evaluation of Teaching Methods, Programmes and Material in Special Education," "Behavior Modification and Therapy," "Methods of Changing the Social Environment on Purpose," "Pain Syndromes," and "Free Papers" on concentration deficit intervention, return to work after coronary artery bypass surgery, rehabilitation after hip replacement, perceptual evaluation in occupational therapy, mobility training following brain trauma, prediction of the range of hand positions available to a patient with movement restrictions at the joints of the upper limb, and others. (JDD)

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Foreword

Rehabilitation research undoubtedly is an urgent need without regard to the stage of development and the structure of services present.

REHABILITATION INTERNATIONAL has urged governments and service providers on local, national, and international levels to ensure the fullest possible integration of and equal participation by people with disabilities in all aspects of the life of their communities.

This target certainly asks for a constant monitoring of concepts and measures in the field of medical, educational, vocational, and social services. Since research is not just directed at the improvement of functions but more frequently at the reduction of handicapping conditions, an interdisciplinary approach is indispensable. The professions involved however use very different tools and strategies, and the Second European Conference on Research in Rehabilitation therefore had been especially designed to enhance the international exchange on such tools and some results of outcome research and measurement.

We have been greatly supported in our endeavour by substantial grants provided by the Commission of the European Communities and the NOWEA – Düsseldorfer Messegesellschaft mbH. The present proceedings have been made possible by funding received from Ertomis Foundation in Wuppertal, and many hours of desk work by Helga Roth and Margitta Wallner.

The results of this Conference unfortunately are published with some delay, but they are just coming in time before the researchers assemble again for the Third European Conference on Research in Rehabilitation held in Rotterdam.

K.-A. Jochheim

Technical Notes

We want to apologize to our readers that choice of expressions and spelling has not been unified. Readers will find contributions with British and American phraseology and spelling. We ask our readers to put up with this inconvenience concerning style for the sake of the economy achieved.

The guest editor has used American diction and spelling for all contributions involving extensive editing.

A selection had to be made of pictures and graphs used in the articles in order to keep costs down. We hope our contributors will appreciate the constraints under which we had to work.

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First Plenary Session

– Monday, 18th November 1985 –

"Research areas, evaluation, criteria for medical, psychological, educational, and social interventions"

Chair: Prof. Sven-Olaf Brattgard, Göteborg, Sweden

Research areas in rehabilitation: Psychological aspects

E. L. Cay, Edinburgh (United Kingdom)

1. Introduction

Tough clinicians involved in rehabilitation have been aware for many years that psychological factors are important in management, systematic research until recently was sparse. Workers tended to examine selected groups of patients and much was anecdotal, psychological factors were assessed in isolation, and the methods of measurement were often crude and inappropriate. – There is no doubt that the picture has changed dramatically in the last decade. Those involved in this field of research, a rapidly growing number, have examined the main issues in many groups of patients: What are the relevant psychological factors in patients with chronic disease? How common are they? Do they influence outcome? How can they be identified? Can they be treated? Which methods of treatment give the best results? Possibly this latter is the most difficult question of all. Implicit in evaluation of treatment is the assumption that we know what constitutes a good or bad outcome, and that this can be measured.

Let us now look critically at each area in turn. We have to be honest in order to differentiate between what is firmly established and what is merely speculation. Only then can we reach an understanding of how much work remains to be done.

2. Relevant psychological factors

There is agreement on the important reasons for maladjustment. The major problems are the patient's reactions, anxiety, depression, or, possibly more significantly, a mixture of these symptoms. Patients do not complain that they are anxious or depressed; they use denial to deal with the situation, be it an acute crisis such as myocardial infarction or prolonged disability such as rheumatoid arthritis. There remains considerable controversy on the role of denial. Some denial is beneficial to the patient as it promotes successful adjustment. With major denial, however, no adjustment is possible. It has been demonstrated that mortality after myocardial infarction is increased in the major deniers.

To these reactions must be added those of the spouse and family. If worried, frightened or overanxious, they react by being overprotective. The patient's pre-illness personality is important, not in terms of personality type but rather whether or not the individual has coped well with other problems or adult life before the illness. The possiblity of organic brain damage is relevant. Impaired higher cognitive functions play a large part in determining whether or not the patient progresses steadily through a rehabilitation programme.

3. Incidence

There is agreement that anxiety and depression are common in patients with chronic illness. Many different groups have now been studied: those attending their primary care physician, with ischaemic heart disease, amputees, those with low back pain, awaiting hip replacement, on renal dialysis, and those referred to a cardiac rehabilitation unit are a few examples. Figures vary of the number of patients with evidence of psychological distress. They depend on the group being studied, the training of the individual making the assessments, and on the method of measurement, clinical interview or a variety of tests. Despite these methodological difficulties, there is a common theme, the severity of psychological symptoms in the course of an illness forms a continuous spectrum, and there is no clear dividing line between normality and abnormality. Minor symptoms are frequent and in the circumstances are not inappropriate. But if the emotional changes themselves cause the patient significant distress and interfere with adjustment and treatment, they are considered to be pathological. About a quarter of the patients fall into this category. They come from all age groups and from different social backgrounds, though women are more willing than men to admit that they are anxious or depressed. These reactions are independent of physical severity, but depend on methods of management, social and family interactions, and prospects of reintegration within the community.

To take the example of the patient after myocardial infarction, anxiety and depression occur in response to real problems which the patient knows face him in discharge from hospital. Work is paramount, but family and financial problems also matter. Left untreated, these symptoms persist. They are also related to mismanagement during the acute illness – overcautious, uncertain staff, lack of education about the illness and its treatment. Previous emotional instability renders it likely that the patient will react badly. Personality factors are important: the type-A patient denies his illness while the inadequate personality evades responsibility by prolonging the sick role. Persisting angina reinforces the emotional disturbance, reminding the patient of his physical limitations.

4. Measurement

The last decade has seen the development of numerous tests to assess psychological well-being and adjustment in many chronic physical illnesses. The great majority were originally developed as research instruments requiring specialist personnel to administer them. As such, their use was restricted in the big centres, and though gradually they are being simplified, shortened and made more suitable for administration in the service setting, it would be foolish to pretend that they are close to being generally acceptable. The clinician, looking for a test to help him to identify the proportion of patients who are having emotional problems in coping with the illness, or who wants to evaluate a particular method of treatment, is now faced with a plethora of tests. He does not know if their norms will be applicable in his group. There are problems in translation, and there is little guidance on whether or not various tests are measuring the same thing or are interchangeable. It is impossible to compare the results of one unit with another. One way out of the difficulty is to administer a battery of tests to each patient, as may happen in multicentre trials, each centre contributing its own well-tried methods. For example, in the International Study of Neurological and Psychological Reactions to Cardiac Surgery, the psychological assessment of the patient *5–10 days post-op* is divided into data obtained by clinical interview, and data obtained from 10 psychological tests. Surely the time is ripe for collaboration between psychologists in different centres to calibrate their own tests against others in similar fields: a form of methodological "housekeeping" to try to bring some order into an increasingly chaotic situation.

5. Effect on outcome

Recognising that many patients with chronic illness are anxious or depressed is important if distress is to be relieved. But, beyond this, does it matter? There is now clear evidence that these patients do less well when various aspects of outcome are measured than their fellows who have adjusted well to their illness. To mention a few examples – patients upset prior to operation have a poorer physical outcome following elective surgery for peptic ulcer than those who are not disturbed; three quarters of those who react well to a myocardial infarction are working as hard as ever within four months, compared to only 20 percent of depressed or anxious patients, though their infarcts were no less severe; and the survival rate over 2 ½ years of patients with chronic renal failure is better in those who are free of upset, have fewer physical symptoms, go back to work, and who have wives who are coping well. Those over-preoccupied with their health and dissatisfied with their life after an infarct are more likely to continue to smoke. In summary, we can say that personality factors are as important as physical symptoms in determining success or failure of treatment, however we decide to measure this.

But we are a long way from being able to state with certainty that we can identify the proportion of patients who will not do well. This requires far more precise definition of successful rehabilitation goals, both in the long and short term, than are currently available.

6. Evaluation of treatment

It is beyond the scope of this paper to detail all the different methods that have been used to treat various groups of patients; educational programmes, group counselling, behaviour modification, group psychotherapy, and relaxation techniques have been employed. Evaluation of these components of a rehabilitation programme is now being undertaken, and early work suggest that, used wisely, they are of benefit to the patient.

A few controlled trials have been carried out, usually testing one of these methods of treatment against a defined outcome measure. In the field of cardiac rehabilitation, for example, studies have shown that:

a) the giving of adequate information when the patient was recovering from a myocardial infarction, provided it was accompanied by concrete evidence of increasing activity, speeded discharge from hospital;

b) behaviour modification techniques were more successful than interviews with their physicians in persuading patients to reduce risk factors, and the effect lasted longer; and

c) in a single, unconfirmed study, patients who received supportive psychotherapy had an increased survival rate of 19 percent one year later when compared to controls.

Overall, there is a dearth of such studies in the field of chronic illness. And there is great need for more research, but advances will only be possible once we have learned how to define our aims much more clearly than can be done at present.

7. Quality of life

This is not to say that attempts have not been made to define "a good outcome". No one could deny that "cure" is quite inappropriate in chronic disease – an unattainable goal. Instead, we talk of trying to improve the patient's quality of life. This sounds on excellent aim, but if left without definition the term is meaningless. "Quality of life" attained the status of a separate heading in the Cumulative Medical Index as recently as 1976. It appears in relation to life on a renal dialysis machine, to chemotherapy for advanced malignant disease, hip replacement, surgery for ischaemic heart disease, after myocardial infarction, ileostomy, senility, and the conduct of homes for the aged and long term wards for the mentally ill. In other words, it relates to chronic, and sometimes terminal illness. It implies life at a price against a background of continuing or increasing disability. It reflects not only changes in the nature of disease patterns but changes in our ability to treat – recognition that much modern treatment is not curative but is directed to making the most of a patient's ability to cope with residual physical symptoms. It also reflects choice in treatment methods. How do we choose the best method of treating an individual at a particular stage of his illness? Effectiveness of treatment certainly must be measured using objective indicators, mortality and recurrence of disease, but excessive concern for their precise measurement may lead to neglect of pertinent but softer subjective indicators. The objective measures may not be sensitive enough to pick out important differences in outcome between, for example, the rehabilitated and the non-rehabilitated patients after myocardial infarction. These two groups may differ considerably in their confidence, adjustment to living with the fact that they have ischaemic heart disease, and in physical capacity, though their mortality rates may be much the same. Quality of life implies that the patient is satisfied with his treatment; his expectations have been fulfilled, his morale is high, and he is confident that he can achieve his goals at work, within the family and among his friends.

It emphasizes the importance of the individual. The physician cannot be satisfied with the role of treating numbers, not people. This is not to decry the importance of physical measures or technical skills; but outcome defined in purely physical terms describes only a part of the whole. The idea that other factors contribute explains discrepancies in outcome: 80–90 percent of patients obtain relief from angina after surgery, but this is not reflected in the number returning to work or resuming an active life. The physician, in deciding how to treat his patient, cannot "impose" a solution; he must take into account the patient's expectations. Patients do not always agree with their physicians. Half of those assessed by a cardiologist as having severe angina did not consider they were handicapped at all. The complicating factor was continuing emotional disturbance; these patients were likely to interpret even the slightest physical symptom as disabling.

Quality of life denotes a wide range of capabilities, limitations, symptoms and psychosocial characteristics that describe the individual's ability to function and derive satisfaction from a variety of roles. If medical or surgical treatment is 100 percent effective, there is no choice. When outcome is not so clear cut, psychological, personality and social factors come into play. Evaluation of rehabilitation interventions must include assessment of outcomes rather than measurement of a single aspect.

We are now in a position to break down quality of life into its components:

Functional capacity: the ability to carry out the activities of daily living, work, leisure activities, family activities including sex. Intellectual function is part of this – the confidence to take decisions, memory, and concentration. Emotional state contributes – anxiety, depression, the sick role, helplessness. Economic state matters – the ability to maintain a satisfactory standard of living.

Patient's attitudes: to the disease, life satisfaction.

Symptoms: handicaps, admission to hospital, amount of treatment and its side effects, and investigations undertaken.

8. Concluding remarks

The implications for future research, evaluating our rehabilitation efforts, are clear. In this field, the day of the single research worker is over. No longer must we think in purely physical or psychological or social terms; integrated multidisciplinary studies using standard methods of measurement offer the best way to advance knowledge. This is not an easy task; such studies are expensive, time consuming, and often difficult to execute. Psychological aspects can be assessed accurately, but we lack a set of simple standardised measuring instruments. But at least we can say today – we have made a promising start!

Research methodology in special education: A framework for practice

R. A. Schindele, Heidelberg (Fed. Rep. of Germany)

1. Introduction: Critique of present research in special education

Criticism about the adequacy of present research on human beings, especially on those who have to develop and live under exceptional conditions, has recently been made by specialists from all quarters of the human and social sciences.

Hensel (1977) has pointed to "the limits of scientific methods in medicine", stressing the importance of developing better methods to study human beings in their individuality and total context. A recent World Health Organization report (WHO 1979, p. 50) postulates "the development of new methods of surveying populations, data collection, data analysis and assessing outcome" as a prerequisite for the improvement of health services. In psychology, Levine (1974, p. 661) states that "those who have worked with clinical and field problems have long chafed with the *lack of scientific method*, as it is usually practised, *to problems faced daily*". He directs his criticism especially "against the *exclusive reliance on experimentation*". Magoon (1977, pp. 686–687) notes that very serious questions have come to be raised regarding the "adequacy of traditional approaches in educational research". His criticism within the area of education is largely substantiated by Bogdan and Biklen (1982) and others.

With regard to research concerning disabled people, Goldberg (1974, p.12) hints at the negative effect of restricted research on theory development, pointing out that "rehabilitation research has lacked a strong theoretical base, because it has attempted to use existing theory developed from other disciplines". Schindele (1980) has pointed to the special methodological problems in rehabilitation research, and described methodological problems and solutions in special education research (Schindele, 1983).

Most criticism of research on the development and education of people with special needs focuses on three shortcomings of present research approaches:

(1) *lack of relevance* of special education research *to* corresponding *practice* (Cave & Maddison, 1978, pp. 172–180; Woodruff, 1976, pp. 112–113; Greenlee, 1977);

(2) limitations in its focus and basic approaches (Hegarty et al., 1981, p. 49; Brown, 1979; Guralnick, 1973; Eaves & McLaughlin, 1977); and

(3) its failure to bring about an integrated body of knowledge, or to contribute adequately to the development of special education theory (Sabitano, 1977; Warren, 1978; Goldberg, 1974).

The reasons for these shortcomings can be attributed to three main factors:

(1) Present research in special education is not sufficiently adapted to the particular needs of this field of practice and the research questions that arise in it.

(2) Special education research faces particular problems of data collection and analysis.

(3) The methodological answers found to these problems are still largel inadequate.

This introductory paper has, therefore, three purposes: First, to outline some priorities regarding the philosophy and aims of research in special education; secondly, to point out some special conditions and problems of research in this field; and finally, to consider some methodological suggestions for improving research in special education.

2. Philosophy and aims of special education research

The direction you travel and the road you walk, determine largely where you go and what you experience on the way. This everyday observation applies very much to special education research: the results and relevance of such research depend largely on the philosophy, aims, and methodology that we apply to it.

It is not feasible here to describe and analyse all possible philosophies and aims of research in special education. It is essential, however, to state at least our major priorities in respect of research objectives. Together with many of the above-mentioned authors, we believe that the following considerations are central to research on the development and education of exceptional children and adolescents.

(1) While – as in all sciences – basic research is indispensable in special education, high priority should be given to applied, problem-oriented research, which elucidates the actual development of the special education client (see Guralnick, 1973; Goldberg, 1974; Muthard, 1980). This belief is strongly supported by Theologos and Stroebel (1980, p. 309), who postulate that "science – especially in the field of rehabilitation research – has to be related to and closely linked with real life, and that improved transformation of research findings up to the so-called ‚final consumer' represents a key task".

(2) Research in special education must try to analyse and evaluate the whole complexity of problems. Special importance attaches to the evaluation of teaching methods, materials and programmes (see Magoon, 1977; Woodruff, 1976; Sabitano, 1977). Research must also take account of "the mutual influence of researchers and subjects and their constructs of reality" (Magoon, 1977).

(3) To support the development of adequate educational programmes for pupils with special needs, research must take account of the total life situation of the individual. The inclusion of social and psychological aspects is, therefore, of special importance.

(4) The various dimensions of the complex development and situation of the exceptional person and his or her education, their interdependence and causal relationship must come into the scope of special education research. To ensure this, such research must not only describe facts, but also strive to understand subjective definitions and complex relationships; discovering meanings is as important as evaluating quantitative facts (see Campbell, 1978). We need "in-depth, penetrating investigation that strives for relational understanding of all the various factors that comprise and affect the object of the . . . the study" (Wolf, 1979, p. 5). "Understanding behaviour from the subject's own frame of reference" (Bogdan & Biklen, 1982, p. 2) must be of primary importance.

(5) Researchers in the field of special education must take into account that the situation, development, and learning of pupils with special needs are not only dependent on educational factors but are also determined by medical, social, psychological, environmental, and developmental influences. Some of the most vital and basic problems in special education can, therefore, be solved only by the application of an interdisciplinary approach to special education research and through the investigation of large populations in their natural environment over a considerable period of time (see Goulet, 1975; Warren, 1978). "The present disorder and confusions [in special educational research] appear to be in part a manifestation of growing pains in an area which demands a multidisciplinary approach but for which too few bridges between the disciplines have been built" (Brown, 1979, p. 144).

3. Special conditions and problems of research in special education

Research into the development and education of people with disability shares many methodological problems with other research dealing with human beings and their development. Where children and young people are concerned, a number of particular considerations arise. Factors relating to the disability and its consequences and to the population of special education clients as a whole, create specific conditions for research and special problem in the design, execution, evaluation and interpretation of such research.

3.1. Special research conditions

To describe fully the special conditions of special education research, at least five aspects have to be considered: the population; the environment; the nature of the education process; measurement instruments and procedures; and ethical and moral considerations.

(1) The *population* (subjects) investigated in special education research tends to show the following characteristics:
(a) extreme heterogeneity between and among groups (Warren, 1977; Hersen & Barlow, 1976; Revenstorf, 1979);
(b) great variability within groups (Hersen & Barlow, 1976; McReynolds & Kearns, 1982);
(c) individual subjects who have particularly complex conditions (and educational programming) (Bergquist & Graham, 1980; Hensel, 1977); and
(d) small numbers of available subjects (Bergquist & Graham, 1980; Revenstorf, 1979).

(2) The *environment*, in which research has to take place, and which is to be influenced by such research, is often characterised by:
(a) a variety of institutional and non-institutional settings with widely differing and strong influences on subjects. (De Jong, 1979; Warren 1978); and
(b) a multiplicity of treatment personnel (Bauer, 1978).

(3) The *special education process* itself, which is the main subject of instructional research and programme evaluation in this area, may show the following specific features, which can strongly influence investigation and research relating to it:
(a) dynamic nature (Bryk & Weisberg, 1977);
(b) complexity and multidimensionality (Levine, 1974); and
(c) singularity and individuality (Hensel, 1977; McReynolds & Kearns, 1982).

(4) Specific research problems in *measurement and data collection* are often caused by the following factors:
(a) the need to adapt tests and procedures to the specific disability or handicap (Goldberg, 1974; Page, 1980; Ulrey & Rogers, 1982);
(b) the lack of norm-referenced instruments for the assessment of pupils with special needs (Goldberg, 1974; Warren, 1978); and
(c) the multiplicity of curricular programmes and the frequent need to develop very individual programmes (Revenstorf, 1979).

(5) *Ethical and moral considerations*, which have a delimiting effect on research methods and strategies in all human and social disciplines, require particular attention in research concerning people who have exceptional developmental and learning conditions. – For such people, any decision about their treatment may have a significant – positive or negative – effect; because of their small number and their dependence on specialist provision, they risk being misused by research (Jonsen, 1978; Haywood, 1976; Hersen & Barlow, 1976; Revenstorf, 1979).

3.2 Methodological problems

It is mainly as a result of the above-mentioned conditions of research in special education that specific problems arise in the design, execution, data analysis, and interpretation of that research. Some problems commonly cited are as follows:

(1) the *establishment of adequate subject groups*, especially in group-referenced experimental designs (Goldberg, 1974; Bryk & Weisberg, 1977; Revenstorf, 1979);

(2) the *representativeness of the research population* (Goldberg, 1974; Guralnick, 1973; Warren, 1978; Revenstorf, 1979);

(3) the *generality of findings* (Hersen & Barlow, 1976) and their clinical significance (Guralnick, 1978);

(4) the danger of failing *internal validity* through intervening variables or regression effects (Revenstorf, 1979) and interaction of variables;

(5) the danger of failing *reliability* through inadequate measurement instruments or procedures (Warren, 1978; Goodstein, 1982);

(6) the danger of *inadequate use of inferential statistics*, especially in significance testing with group designs (Carver, 1978; Kazdin, 1976); and

(7) the *lack of individual and process-oriented data* (Revenstorf, 1979; Bogdan & Biklen, 1982; McReynolds & Kearns, 1982).

3.3 Major issues in the current debate on adequate research methodology in special education

In the light of the above-mentioned criticisms of present research in special education, and taking account of the particular conditions and methodological problems that arise, we should not be surprised that, in recent years, a lively discussion on adequate research in this field has taken place. In many instances, this debate has been quite controversial. Within the limited space of this contribution, it is only possible to hint at the major issues raised.

(1) Some participants in this debate point to the major *limitations of experimental design and statistical inference* in respect of significance testing, generalization, and predictability. Of the many publications which have questioned the omnipotence of the scientific paradigm based on experimental designs, with corresponding evaluation through inferential statistics, only a few need to be listed here: 'The case against statistical significance testing' (Carver, 1978); 'Validity shrinkage in psychological research: An example of the need for caution' (Koretz, 1979); 'Beyond the two disciplines of scientific psychology' (Cronbach, 1975); 'The limits of scientific methods in medicine' (Hensel, 1977); and 'Scientific method and the adversary model' (Levine, 1974). It is of considerable interest that researchers who were prominent in the quantitative tradition, began to question this perspective and to advocate the use of methods deviating from the purely quantitative and experimental paradigm (see, for example, Bronfenbrenner, 1976; Campbell, 1978; Cronbach, 1975; see also Bogdan & Biklen, 1982, p. 21).

(2) In addition to drawing attention to the limitations of purely quantiative experimental designs, many authors point out that it is often difficult, if not impossible, to meet the requisite conditions for applying these designs to human samples. Thus, the assumption of a normally-distributed sample is often questionable for disabled populations (Warren, 1977; Payton, 1979). Error variance can be increased by the inadequacy of tests and data collection procedures, and by the interrelationship between variables and their corresponding impact. Levine (1974) summarizes these arguments by saying that "the logic of experimentation and statistical inference demands conditions that are difficult, if not impossible, to meet in human studies . . . Social-psychological phenomena are, by their very nature, inherently more complex than the phenomena of physical sciences, for which the experiment may well provide suitable methodology".

(3) Aside from such criticism, it is increasingly being asked whether the present shortcomings of research in special education may not be caused by the fact that such research is dominated by the quantitative, experimental research approach. The basic assumptions and

prerequisites of quantitative-experimental research may be in open conflict with the nature of special education research and with the basic needs and objectives that must be met by such research.

Wilson (1977) and Rist (1980) stress the importance of qualitative knowing in human and social research. They are strongly supported by Levine (1974) who makes us aware that "we have accepted uncritically the notion, 'that which exists, exists in quantity and can be measured', and the insidious corollary that if concepts cannot be reduced to quantitative treatment, we are dealing with unscientific material" (p. 667). Chanan (1978, p. 5) argues that the separation and controlling of variables in such research often "means deliberately screening out the complexity of the issue, their multiple interrelations too diverse for the available statistical model".

All these statements support Goldberg's postulation (1974, p. 13) that "the rehabilitation professions must rid themselves of the academic bias against applied research which cannot be placed within the traditional bounds of hypothesis testing and experimental design". They make us understand that "today there is a vigorous search for alternatives to the quantitative-experimental approach . . . [and that] in academic social science there is renewed emphasis on the methods of humanities and increased doubts as to the appropriateness of the natural science model to social science problems" (Campbell, 1978, p. 184).

4. Methodological suggestions for improved special education research

Within the framework of this paper, it is not possible to give a comprehensive account of the methodological and evaluative approaches required in this area of research. The following list of suggestions outlines briefly some of the approaches that might lead to better research in special education. Detailed descriptions of these approaches and concrete applied examples can be found in the references cited.

4.1 Application of more adequate research designs

The application of inadequate research designs may often be the reason for results of little significance and relevance in special education. Too many specialists in our area try to be scientific by applying experimental designs, as they have been developed in the natural sciences and applied largely in psychology. Very often, however, quite simple experimental designs are used although the subject to be investigated requires a much more sophisticated design.

Some of the suggestions put forward by those who seek better research designs for special education research are the following.

(1) *More complicated research designs are often needed.* Thus, many researchers who rely on group-referenced quantitative research, are beginning systematically to test the potential of the more complex and sophisticated research designs that have been developed in the natural and social sciences in recent years. Kornmann (1976), for example, recommends the increased use of multivariate research designs, which have only rarely been used in recent special education research. Extensive and careful use of multiple baseline designs in group research is suggested by Strain and Shores (1979) and by Cuvo (1979). Possibilities of applying time-series designs in group research are indicated by Hersen and Barlow (1976) and Revenstorf (1979). Payton (1979) gives examples of the application of the serial or sequential trial design, which has been used mainly in medicine as an alternative to the normal control group design.

(2) *Increased application of single-subject* or within-subject experimental designs is strongly recommended by an increasing number of authors. Such designs seem in a majority of cases to be particularly relevant to the specific subjects and research problems of special education

research. More and more researchers who continue to adhere to the experimental and quantitative approach are therefore applying such designs. At the same time, new variations of single-subject research designs are being published. Comprehensive descriptions of such designs are given by Glass et al. (1974), Hersen and Barlow (1976), Kazdin (1976 and 1978), Hopkins and Kretke (1976), Guralnick (1978), Krathwohl (1977), Revenstorf (1979), Hacker (1980), Petermann (1982), Whitehead (1982), and McReynolds and Kearns (1982). In summarizing the published suggestions to date, McReynolds and Kearns (1982) propose the following categories or within-subject research designs: withdrawal and reversal designs in the A-B-A or A-B-A-B form; multiple baseline designs across behaviours, settings, subjects, and groups; and more complicated variations of the basic model of multiple baseline design, like the alternating treatments design, the interaction design, the changing criterion design, and the multiple probe design. Like many other authors, they present examples of data and corresponding ways of evaluating them by newly developed statistical techniques.

(3) With complex research problems or situations, there is a need for correspondingly *complex or mixed research strategies*. Such mixed research designs seem especially appropriate to projects where both quantitative and qualitative methodological approaches are necessary, and where the data collection and evaluation are directed both to groups and to intensive investigation of individual situations (Jehle, 1982). Kratochwill et al. (1979) have suggested the combination of conventional multi-subject research with the time-series design directed to individual evaluation. Bergquist and Graham (1980) present the combination of multiple-baseline and multiple-probe designs as a practical alternative to special education assessment and evaluation. The multi-level model is suggested by Warren (1978) for special education research which aims at evaluation on the aetiological, evaluative and functional levels.

(4) Particularly in studies on special education institutions, organizations and programmes, increased application of research designs and techniques, as recently developed within *evaluation and operational research*, could lead to more adequate data collection, analysis and interpretation (see Rutman, 1977; Maher & Barbrack 1979).

4.2 More adequate and more systematic application of qualitative research methodology

More and more special education researchers, who, through their practical experience, have learnt about the limitations of purely quantitative-experimental research in our area, begin to include the qualitative approach in their research. The importance of qualitative approaches in special education has been stressed by a number of specialists like Campbell (1978), Wolf and Tymitz (1977), Wolf (1979), Schindele (1980), and Bogdan and Biklen (1982). Examples and detailed descriptions of such methods have been presented by Lutz and Ramsey (1974) for anthropological methods, by Overholt and Stallings (1976) and by Wilson (1977) for ethnographic research, by Bronfenbrenner (1976) and by Thomas and Marshall (1977) for ecological research approaches, and by Magoon (1977) for constructivist research.

Bogdan and Biklen, who use ‚qualitative research' as an umbrella term for all these approaches, identify the following characteristics and advantages of such research: "Qualitative research has the natural setting as the direct source of data and the researcher is the key instrument . . . [Such] research is descriptive . . . Qualitative researchers are concerned with process rather than simply with outcomes or products . . . [They] tend to analyse their data inductively . . . Meaning is of essential concern to the qualitative approach" (1982, pp. 27–30). They also demonstrate that adequate qualitative data collection, description and analysis can meet many of the criteria of the ‚scientific method', even as they are stated by the proponents of the quantitative-experimental approach. A combination of quantitative-experimental approaches and qualitative research methods in the same project seems to be possible according to their experience. "Observation, reviewing various documents and artifacts, participant observation [and] open-ended interviewing" (p. 47) are regarded by them as predominant procedures of data collection within the qualitative approach.

4.3 Increased application of the principles of action research

The action research approach seems to be particularly appropriate for investigations in special education, especially for the evaluation of instructional methods, materials and programmes. This approach implies an optimal chance for the application of research findings, because it eliminates the distance between research and practitioner (Aronson & Sherwood, 1974; Florio & Walsh, 1978; Warren, 1978) and also seeks to include the research subjects in research decisions (Goldberg, 1974; Kratochwill et al., 1979). The need for flexibility in research design often results in a multiplicity of quantitative and qualitative strategies of data collection and analysis. Its major objective is to bring research and practice together deliberately in a creative interplay (Hegarty et al., 1981, 1982). This methodological approach has, therefore, an optimal potential to contribute to most of the research objectives vital to special education research.

4.4 Application of more adequate statistical procedures for data analysis

The gap which is currently developing between supporters of quantitative and qualitative research in special education could, in many cases, be bridged if both sides had a better understanding of the full range of statistical techniques available. A number of such approaches, which allow more differentiated analysis of group data or the statistical analysis of data from single-case studies, are only rarely used in special education investigation, despite their particular value in this field.

(1) Within the area of *group designs*, the use of factor analysis has been recommended by Bolton (1972 and 1975) and Kornmann (1976), especially for the description of intercorrelations between variables. The application of cluster analysis and dimension analysis has been suggested by Kornmann (1976) for *a priori* classification of groups, while he regards discriminant analysis as the corresponding procedure for *a posteriori* classification of groups. The use of causal analysis and path analysis has been demonstrated by Flynn (1975) in a project on determinants of rehabilitation rate. Increased application of analysis of variance and analysis of regression is suggested by Kornmann (1976) for analysing "which conditions or constellations of conditions explain which differences of individual traits". The importance of applying adequate strategies to control intervening effects, e. g. through analysis of regression or covariance, has been underlined by Revenstorf (1979).

(2) In respect of *single-subject research*, procedures for statistical analysis have been presented for data on the individual level, and for group-referenced analysis on the basis of single cases: Kazdin (1976), referring to Revusky (1967), offers various procedures like variations of t-test and analysis of variance (ANOVA), time-series analysis, randomization tests, R*n* statistics, and the split-middle method. In their chapter on statistical criteria for evaluating treatment effectiveness, Bogdan and Biklen (1982) recommend the interrupted time-series analysis (ITSA) as an adequate way of applying inferential statistics within single-subject designs. While they see many difficulties in meeting the requisite statistical assumptions, and therefore stress the importance of visual presentation of descriptive data in such designs, they admit that inferential statistical evaluation of data in single-subject research is constantly increasing and that it can be in many cases a powerful addition to the descriptive analysis of data. Examples of the application of statistics in single-case research are presented by Hopkins and Kretke (1976) for analysis of variance; by Revenstorf (1979) for time-series analysis; and by White (1974) for the split-middle technique. A global

discussion of the role of statistics in single-subject research is presented by Wolery and Harris (1982).

4.5 Development of adequate measuring instruments and procedures

As mentioned above, inadequate measuring instruments and procedures are often the cause of unreliable results in special education research. This points to the need for developments in at least four areas:

(1) the development of adapted tests and test procedures for various groups of pupils with special needs (Page, 1980; Salvia & Ysseldyke, 1981);

(2) the development of test norms which are appropriate to the pupil with special needs and which allow, wherever possible, fair comparison with so-called normal pupils (Warren, 1978);

(3) the development of treatment-oriented (criterion-referenced) tests both for groups and for individuals with special needs (Popham, 1978; Howell, 1978); and

(4) the development of reliable instruments and procedures for more qualitative data collection.

5. Concluding remarks

This analysis of literature on methodological problems and solutions allows a number of conclusions to be drawn about necessary future developments in this area. Only four – which are, in our view, of the utmost importance – are given here.

(1) Research methodology in special education is in *great need of systematic further development* both in approaches and designs and in statistical evaluations. Too much research in this field is still unreliable, lacking in significance, and of little relevance to practice.

(2) High priority should be given to *multi- and interdisciplinary research*, by including various specialists from the disciplines vital to the adequate solution of the particular research problem.

(3) As available funds and personnel are limited, the most vital and more basic problems can be solved only by *close international co-operation* between corresponding specialists.

(4) The increasing *discussion about aims and objectives* of research on the development and education of pupils with special needs must be contined and intensified, to make every researcher aware of the close link between research objectives and methods, and of the impact such research has on practice.

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Social aspects of rehabilitation

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In 1870, Sir Francis Galton, the eminent Victorian scientist, and author of Hereditary Genius, published a study on the efficacy of prayer. His religious scepticism had been developing over a number of years, including the critical observation of seances and other religious activities, and he had decided to try to come to some conclusions on the subject. He began by nothing that the Bible expressed the view that blessings, both spiritual and temporal, should be asked for in prayer. But the question was: Did it make any difference? One way of finding out, Galton reasoned, was to look at the longevity of prayerful people, and those who are prayed for. Galton constructed a table which showed the mean age at death for the 'prayerful' occupation of the clergy as 69.49 years, compared with 68.14 for lawyers and, I am afraid to say, 67.31 for doctors. So clergymen did live longer but not by much, and Galton argued that good country living probably explained the difference.

When he considered those who were prayed for, Monarchs presented themselves as ideal candidates: Petitions were (and are) frequently made for the long life of Kings and Queens. Unfortunately, (like missionaries) their life expectancy turned out to be rather disappointing, having an average of 64.04 years compared with that of 70.22 of the English gentry.

A furor broke out in the pages of the Spectator. Galton was attacked not just for his irreverance and agnosticism but also for his research methodology. In particular Galton was criticised for failing to distinguish between the genuine and earnest prayers of individuals and mere formal petitions, which could not be regarded as real prayers. The debate raged on without conclusion, although Galton appears to have taken it all in his stride. Forrest (1974) remarks that by the end of the episode Galton was 'safely ensconced in the milieu of militant scientific freethought'.

What are the morals of this story? I think they are twofold. Firstly, the desire to measure 'subjective' as well as 'objective' facets of life is not new. The desire for measurement is deeply rooted in our culture, and not just in our recent past. Secondly, different groups frequently differ over the definition of problems, the appropriateness of specific measurements, and what is to count as the measurable outcome of a given action or behaviour. It is, perhaps, worth having these points in mind as we approach research into social aspects of rehabilitation.

In rehabilitation a lot of debate has occurred about the appropriateness of measurement and the validity of instruments being used. In particular, measures of Activities of Daily Living (ADL), widely employed by both practitioners and researchers, have come in for quite a lot of criticism. These instruments, which rely on a checklist of activities and are then 'summed' to give a measurement of severity, have been criticised for presuming that individual items have equal weight. This is similar to the critique of 'dictionary' instruments in other areas of research, for example in 'life event' research (Craig & Brown, 1984). Duckworth (1980) points out that scores on ADL checklists may also 'sample' possible responses; for example pain or stiffness may differ at different times of the day, thus introducing serious possibilities of bias. In addition, ADL indices are often too crude to detect change in rehabilitation where improvement may well be modest and not picked up by simple Yes/No responses to a given item (Ashburn, 1985). This problem of 'sensitivity' in particular reduces the value of using ADL scores in assessing interventions.

However, it is important in developing such criticisms not to close down the debate too prematurely. ADL measures may be of limited use but migth still be appropriate in specific circumstances and for particular aspects of research. For example, in a recent study being conducted by Ray Fitzpatrick and myself, in collaboration with Dr. Andrew Frank at Northwick Park Hospital in Great Britain, we have found that the use of an existing ADL index, adapted for the purpose of assessing the impact of back pain on everyday life (Roland & Morris, 1983), predicted some key aspects of experience, as Table 1 indicates. Those respondents who scored "Yes" on 14 or more items in a 24 item schedule, were rated by us as being more severely disabled than those who scored less than 14.

Table 1: *Disability and Expectations of Treatment.* (From a study of back pain, N = 58)

Severe disability (scoring 14 or more items on an adapted FLP index, Roland & Morris 1983) correlated significantly with

- Expectations to discuss family problems with doctor ($P < 0.05$)
- Reporting their family lives as having been adversely affected by back pain ($P < 0.05$)

Severe disability, defined in this way, turned out to correlate well with other important components in the study. In particular, the severe group expected to discuss family problems with the clinic doctor, and reported their lives to be adversely affected by back pain. Thus the disability measures distinguished patients in important respects; whilst some patients wanted help with family problems, not all did, and not all reported that such problems were important to them. This kind of variation between patients warns us against assuming a homogeneity amongst those going through specific treatment or rehabilitation programms.

Having said that, it is clear that disability, however measured, should not be seen in isolation, if only because it places individuals and their families at considerable risk of disadvantage, that is, of facing *handicap.* Two dimensions of handicap are emerging from recent research, and deserve mention here. The first is *material disadvantage.* Harris (1971) found that the median weekly income of the disabled was 50 percent of that found in the general population (Bury, 1979), though of course the overlap with financial problems facing the elderly is evident here. Townsend (1979), however, has shown that appreciable and severe disability have a strong relationship with material circumstances. People with appreciable or severe disability are three times more likely to live in poverty than the able-bodied (Walker, 1981).

In addition to these dimensions, it is also being recognised that *social disadvantage* may be equally important, particularly in such matters as social isolation (Strauss, 1975). People with disabilities may well invest additional time in resting in order to cope with symptoms, or withdraw from social interaction altogether. Such alterations in life style may or may not be reflected in material hardship, but in any case such handicap is likely to have a direct effect on patient assessments of the relevance of services, of professional interventions and of their outcome. In turn, how these problems facing people with disabilities, and their carers, are defined and recognised by professionals can directly influence the quality of care (Blaxter, 1976; Locker, 1983).

One way of approaching these issues is to look more directly at the expectations patients and providers have of services. I have already indicated that disability and expectations of treatment are linked, and both are worth examining as components of experience. Research on patient expectations in rehabilitation is expanding, and I have recently reviewed some aspects of the issue elsewhere (Bury, 1985). It is clear from this research, however, that studies are doing more than simply drawing attention to an ever increasing number of problems. They are also furthering the application of research methods and suggesting ways in which some of the difficulties may be rectified in practice.

Perhaps I could mention two recent examples by way of illustration. Potts et al. (1984) found in a study of rheumatoid arthritis that patients expected information about their disease and help with financial difficulties, whereas staff stressed providing aids and sexual counselling. The authors argue for greater attention to discontinuities in patient-provider expectations as a means of enhancing outcome, and to more relevant information and patient education concerning disease processes. Roberts et al. (1984), in a study of surgery for back pain, found quite wide differences between patients' and doctors' views about outcomes, in particular about the degree of success of recovery. Doctors consistently overestimated the effectiveness of their treatment, and failed to predict the majority of those who rated themselves as 'not improved' and who were later candidates for further treatment. The authors suggest that self-reports and questionnaire assessments of outcome can be useful tools alongside (and, perhaps, as a check on) professionals' assessments.

A further aspect in this developing picture of the social dimensions of rehabilitation, is the broad area of 'health beliefs'. This work has drawn on anthropological views of beliefs about health, and on psychological work on attitudes. As with measures of ADL, the attempt to standardise a *Health Belief Model* (HBM) has created a lively debate. Scambler (1984), for example, argues that it is probably more appropriate to describe the HBM as 'a conceptual framework for thinking about illness behaviour than as a *model*' (p. 38). Nonetheless, he accepts that it constitutes a productive approach to health service evaluation, and parts of it are being used in a variety of studies (especially concerning preventative health behaviour and compliance, e. g. Calnan & Moss, 1984). It is also being used in the study of back pain being conducted by Ray Fitzpatrick and myself, mentioned earlier in this paper.

One of the dimensions of the approach concerns the *Health Locus of Control* (Wallston & Wallston, 1978). Respondents are asked to state their beliefs on a number of different scales, which, it is hoped, are linked to important health-related behaviours. Several recent studies have examined the role, for example, of fatalism in beliefs about health (Pill & Stott, 1982; Blaxter, 1983), and whilst it is important not to create fixed stereotypes in this regard, it has been found that social groups do differ in their views of how much they can influence their own health. The *Chance Health Locus of Control* scale offers respondents such statements as "most things that affect my health happen by accident", and asks them to respond on a 5-point scale ranging from 'strongly agree' to 'strongly disagree'. Other scales operationalise such dimensions as *Internal Health Locus of Control*, with statements such as, "If I take the right actions I can stay healthy", which attempt to measure how far the individual feels he/she is able to influence his/her health. Similarly, the *Powerful Others Locus of Control* scale examines what part 'powerful others' play in beliefs about health. An example of a statement on this scale would be, "Having regular contact with my doctor is the best way for me to avoid illness." The assumption here is that variations in the way people view health, especially the importance of personal behaviour, the environment and the role of professional help in health, will influence the use and response to services.

Most studies using the HBM have shown interesting, if partial, results for the role of beliefs in health behaviours. In our own study, health beliefs also offered a limited appreciation of disability experience, but the Powerful Others scale in particular did predict some important expectations of treatment, and examples of some positive associations are shown in Table 2. Those with low scores on the Powerful Others scale were significantly less likely to report that they expected medicine to offer a good understanding of back pain. Nor did these respondents expect discussions with the doctor about their family life. They were not looking for broad interventions, expecting only limited treatment. This is confirmed by the third example showing that the same patients did not want discussions with the doctor concerning aids and appliances. I have already noted that expectations in this respect were low for the patient group as a whole, but it is of interest to note that such respondents were significantly more likely to report being less concerned with contact with doctors.

Table 2: *Health Locus of Control and Expectations.* (From a study of back pain. $N = 58$)

Those with low scores on Powerful Others Scale are more likely to report that:
- Medicine does not have a good understanding of back pain ($P < 0.05$)
- They did not expect a discussion with the doctor about their family life ($P < 0.01$)
- They did not want a discussion of aids that might assist mobility ($P < 0.05$)

These findings are in line with other recent studies on health beliefs and rehabilitation, for example, that of Lorig et al. (1984) who found that health beliefs (about arthritis) varied both between patient groups (between Caucasian and Spanish speaking patients), and between patients and physicians. They conclude that more responsive patient education and treatment must be based directly on patients' perceptions, rather than on physicians' beliefs about patients' beliefs. They argue that there is a need for caution on the part of professionals when assessing knowledge of patients' beliefs, and that interventions should be introduced in ways that are more congruent with the outlook of patients.

This brief exposition of a social approach to disablement and rehabilitation has outlined three components of experience. First, disability and handicap remain important issues, in both research and policy. Whilst much disability can be minor in character, those individuals developing appreciable and serious disabilities are particularly vulnerable. Even limited instruments such as ADL schedules are able to predict important aspects of experience, expressing the serious effects that disability has on social life. – Second, a social perspective directs attention towards a wider appreciation of patient experiences, and, just as importantly, those of families and carers. I have only been able to mention at various points in this paper the views patients have of family relationships and the impact of disability on them. It is clear that there are considerable variations in the willingness of patients to report that disability has an important influence on family life. These responses are, of course, open to a variety of interpretations; some may be coping responses, others may be a direct reflection of the varying impact of disability. In any event, a more careful appreciation of experience in this regard should assist the development of more responsive services, and not just to the individual. It is increasingly recognised that carers play a critical role in disability and rehabilitation, and that they should occupy a primary and legitimate place in the delivery of health care. This will inevitably become clearer as research on carers' needs and perceptions develop and are placed alongside those of patients and providers (Jones & Vetter, 1984). Finally, I have attempted to draw attention to the role that patient expectations and health beliefs may play in rehabilitation. These two aspects need to be combined with disability and handicap issues. That such 'subjective' dimensions are demonstrably 'objective' in their effects means that they need to be taken seriously. Current research is beginning to show how this might be done, and I hope that I have been able to convey some of the issues involved. The bringing together of measures of disablement and of patient experience are opening up exciting and perhaps important avenues for research and the development of health care. At the least, it is to be hoped that such endeavours will not produce quite as violent a reaction as greeted Francis Galton's study of prayer a hundred years ago.

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Research methodology in rehabilitation: The role of randomized trials

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Randomized clinical trials have been used particularly during recent years, when the development of new drugs has been very rapid and scientifically valid knowledge about the effects and side effects of drugs became a necessity. The classical example of randomized drug trials is that performed to test the efficacy of streptomycine in the treatment of pulmonary tuberculosis (Medical Research Council, 1948). A distinct effect was found, as patients belonging to the drug intervention group showed marked clinical improvement and rapidly disappearing tuberculotic nodules in chest x-ray. Similar, although less drastic, results have been obtained in studies on some other drugs, when the endpoints have been relatively unequivocal, such as changes in well-defined clinical variables, and the intervention period has been relatively short, often a few months only, and the diagnostic criteria easily defined.

This positive view, based on short-term drug trials, becomes somewhat gloomy when we consider randomized trials aimed at improving the prognosis of certain chronic diseases, such as coronary heart disease or mild hypertension. The problem is even worse when the study aims at primary prevention of chronic diseases. Usually in trials of this type, large numbers of patient years are needed in order to get a reasonable amount of patients who fulfill the endpoint criteria. This means that either the initial sample of patients must be sizable, or the intervention and follow-up periods long. The problem of a reasonable sample size must often be solved by collecting the patients from several centres, which requires careful standardization of methods and a meticulous protocol. This may be difficult to achieve, partly due to high costs. If the intervention and follow-up period is long, there is the problem of poor adherence and drop-out from the intervention group, and the drop-in or contamination of the control patients. Furthermore, a prolonged follow-up may cause problems connected with staff changes, etc. As some of the big randomized trials concerning both primary and secondary prevention of coronary heart disease have shown, the aforementioned problems have made the results controversial and difficult to explain from the point of view of the primary aims. Nevertheless, they have yielded important information in many other respects and shed light on the problematic subject of chronic heart disease.

When we consider the use of a randomized trial as an approach to research in rehabilitation, much of what we said earlier about the problems is applicable to this field as well. If the study being planned aims at evaluating a relatively simple and straightforward problem of medical rehabilitation, such as the combined effect of physiotherapy and use of drugs on the shoulder mobility in patients with periarthritis as compared with drug treatment only, a randomized trial may be the best type of research design. In studies of this type, the diagnostic criteria are easy to define, the intervention can be standardized, the endpoints are easy to agree upon and relatively easy to measure accurately. Clinical investigators should be encouraged to design and perform randomized controlled studies in order to evaluate properly the effects of medical rehabilitation measures which are being used at present without adequate scientific foundation. This applies, in particular, to many forms of physical medicine, such as ultrasound in the treatment of chronic pain, or traction of the spine in patients with low back or neck pain. Special attention has to be paid to measurement of intervention effects, because single- or double-blind trials are usually not applicable.

Objective measurement of treatment effects may be invalidated by differences in data accuracy between groups. This may be a consequence of the fact that the trial staff is often involved in intervention, and thus come to know one group (the intensive intervention group) better than the other group(s). The use of independent reviewers, not involved in intervention, may be advocated if the objective assessment of effects is a really critical issue in the randomized trial.

Comparable treatment groups at baseline are usually achieved by simple randomization. It has also become a practice to try to balance treatment groups according to factors related to prognosis. The problem is that there is too little knowledge about these factors. One is often left with no possibility except to undertake stratified randomization, with strata defined by age and/or sex. Each stratum is randomized according to its own scheme. Equal sizes of treatment groups are achieved by use of random permutations instead of random numbers. In order to prevent undesired detection of treatment group allocations in advance, one should use permutations of length six or eight when allocating consecutive patients into two groups.

As an example of a small randomized trial, we should like to mention a study of patients with non-insulin dependent diabetes (NIDD). This study, performed in the Rehabilitation Research Centre in Turku, aimed at investigating the effects of a typical medical rehabilitation measure, i. e. physical exercise, on the balance of diabetes, which is considered to be important from the point of view of long-term prognosis (Rönnemaa et al., 1984). The study comprised 25 NIDD patients, who were randomly allocated into two groups, one with a physical exercise program and the other with routine treatment. The evaluation was performed after 4 months' intervention. The results suggested that, with physical exercise, glycemic control and glucose tolerance may improve, together with VO_2 max (Table 1). This example shows that it is possible to show therapeutic effects even in a relatively small randomized trial when the endpoints are comparatively simple and the effect of intervention is marked enough.

Table 1: *Results of a randomized trial on the effects of physical exercise in patients with type II diabetes* (Rönnemaa et al., 1984)

	Exercise N = 13		Control N = 12		
	0	4	0	4	Months
Glycosylated HbA$_1$ (%)	9.6	8.6*	10.0	9.9	
SD	± 1.6	± 1.9	± 1.5	± 1.7	
Plasma glucose 2 hr. GTT (mmol/l)	19.7	16.5*	19.6	19.7	
SD	± 4.9	± 7.6	± 4.1	± 2.7	
VO_2 max (ml/min/kg)	26.7	29.3**	25.8	25.9	
SD	± 6.5	± 6.2	± 6.3	± 6.7	

* $p < .01$
** $p < .001$

Recently, the results of a large WHO-coordinated multicentre study were published (World Health Organization, 1983). This randomized trial was performed on patients after myocardial infarction, with the aim of studying the effects of a comprehensive rehabilitation and secondary prevention program on morbidity, mortality, risk factors, physical capacity, and psychosocial adaptation. Altogether 24 centres in 17 countries participated in this study.

recruiting 3.184 patients. Seven centres, however, had to be left out of the final analysis due to poor adherence, inadequate follow-up, and high drop-out from the trial, leaving 2.056 patients for final evaluation. The results from different centres could, however, not be pooled because of many problems, such as insufficient standardization of methods, and poor adherence to the protocol. The study thus failed to give the answer to the difficult problem of the effects of a comprehensive rehabilitation and secondary prevention program after myocardial infarction. Important knowledge and experience was however gained (Kallio & Cay, 1985). In a few participating centres, the study was more successful, and some of the results of the Finnish substudy performed in Turku and Helsinki are briefly summarized here (Kallio et al., 1979). The Finnish study included altogether 375 patients after acute myocardial infarction below 65 years, 187 in the intervention group, and 188 in the control group. The groups were fully comparable at the baseline regarding previous history, hospital findings, and risk indicators. The control patients were treated according to the normal routine, while the intervention group patients underwent a comprehensive multifactor rehabilitation program, which was most intensive during the first three months. The patients of both groups were seen by the study team 1, 2, and 3 years after the acute myocardial infarction. The risk indicators were significantly lower in the intervention group compared with the controls (Table 2). A significantly smaller number of sudden deaths (Fig. 1) and coronary mortality compared with the control patients was also observed.

Table 2: *Risk indicators in patients with myocardial infarction participating in a Finnish multifactorial intervention trial* (Kallio et al., 1979); I = Intervention group, C = Control group

	1 year			3 years		
	I		C	I		C
Weight (kg)	72	**	75	72	n.s.	75
SD	± 10.6		± 12.2	± 10.6		± 12.1
Serum cholesterol (mmol/l)	6.5	***	7.3	6.5	***	7.4
SD	± 1.2		± 1.5	± 1.2		± 1.4
Serum triglycerides (mmol/l)	1.6	**	2.0	1.6	*	1.9
SD	± 1.0		± 1.1	± 0.5		± 1.4
Systolic blood pressure (mmHg)	135	**	143	136	**	145
SD	± 20.7		± 20.8	± 23.6		± 21.7
Diastolic blood pressure (mmHg)	85	**	89	85	**	88
SD	± 10.3		± 11.6	± 11.1		± 10.8
Stopped smoking (%)	50	n.s.	42	54	n.s.	51

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$
n.s. = not significant

The Finnish experience suggested that it is possible to use the framework of a randomized trial also in a relatively long-term and comprehensive study when the diagnostic criteria are uniform, the protocol meticulously designed, the drop-out kept to minimum, and, in addition, the rate of endpoints relatively high. It must, however, be pointed out that this kind of approach does not allow an analysis of the effects of a single intervention measure, as the results reflect the overall result of the total intervention program. In order to measure effects of single intervention measures one should use factorial trials. Another recent study based on random allocation in a normal care and a rehabilitation group of patients after lumbar diskectomy was performed in the Rehabilitation Research Centre in Turku to investigate how well organized ambulatory care compares with a comprehensive rehabilitation program administered in a rehabilitation centre (Alaranta et al., unpublished observations). The study comprised 212 patients randomly allocated in a normal care or a

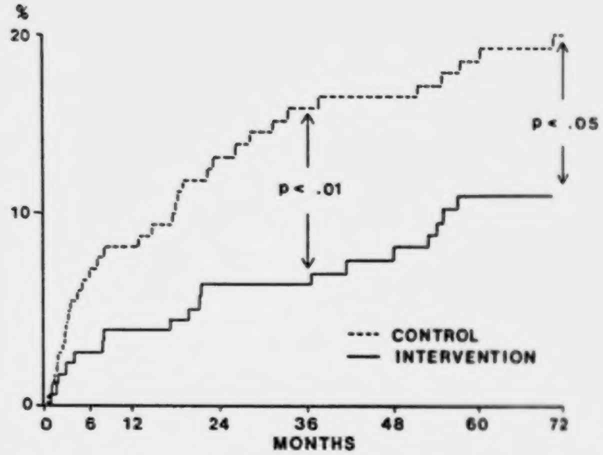

Figure 1: *Cumulative number of sudden deaths in a Finnish multifactorial intervention trial on patients after myocardial infarction* (Kallio & al., 1979; Kallio & al., 1985)

rehabilitation group, followed up for one year after the operation. No significant differences were seen in the distribution of handicap, in return to work, or in the amount of sick leave days, between the two groups. The design of the study, a randomized clinical trial, worked out well.

The problem of designing a randomized multicentre trial to study the effects of comprehensive rehabilitation aiming at social integration and improvement of quality of life may be somewhat more difficult. This is partly due to the difficult operationalization of social integration and quality of life, and thus to problems in the characterization and measurement of endpoints. If these difficulties are overcome, there will remain the problems of cross-cultural differences which may limit the international applicability of the results. These may also invalidate an attempt at endpoint standardization in the case of an international multicentre trial. The problem of measurement of outcome variables of rehabilitation is, however, inherent in rehabilitation research in general, irrespective of the design of the study.

It has been pointed out that more attention should be given to scientific principles, rather than mathematical procedures, in observational research, and strategies should be developed for using the scientific structure of randomized trials as a guide to design research in circumstances where randomization is impossible or unfeasible (Feinstein, 1984). A practical example of a situation when randomized study is unfeasible is the evaluation of the effects of rehabilitation in patients with a rare disablement (Byar et al., 1976). In this case, a randomized trial can not be performed due to an insufficient number of patients available for study.

In conclusion, we should like to quote a recent editorial about randomized clinical trials in the field of cardiology (Rahimtoola, 1985): "We need to dissect out questions of interest and do research studies and, if necessary, perform small randomized trials to answer these questions . . . The large multicentre randomized clinical trials should be considered a last resort to obtaining answers."

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A medical view of research methodology in rehabilitation

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– Amended version –

The methods of research must depend on the purpose of the enquiry, but all should be of known reliability and validity. Is the method producing consistent results, and is it recording what it is intending to measure?

Impairment is usually easy to measure. There is more controversy about disability because there are many methods to assess reduced function. Handicap is open to confusion because social disadvantage is dependent upon factors in the environment and society as well as in the patient. Outcome of clinical management is usually required in terms of disability and of handicap, e. g. distance and speed of walking, or time to return to work.

For most research purposes, it is best to measure physical, psychological and social factors somewhat independently and yet take account of each factor dependent on the others. Standardised schedules are best to be used such as the Barthel index of dependency. Comparative studies often reveal the greatest insights. Methods that are to be used in ordinary clinical practice need to be straightforwardly understood and brief. Attention must be paid to ensure that the sample of patients studied is representative, so that the results can be extrapolated to a population. Assessments may differ from the viewpoint of the various professions, and of the patient and his relatives. Those perceiving the requirements from the medical view must be reminded continually that it is what the patient wants that is what matters.

1. Introduction

It is trite but true that the rules of science should be applied in any research about disability. The challenge is to achieve the universal application of these rules. This is difficult because of the breadth of the research requirement (Kallio, 1982). The methodology of the research must depend on the purpose of the enquiry (e. g. WHO, 1982). Professional staff involved in rehabilitation services should have a broad base for their knowledge, whether as clinicians or academics, yet the research topic may have to be narrow to be worthwhile.

Disability can be studied virtually from the cellular level to the societal level. Studies need to be based on a usually accepted academic discipline, ranging from physiology to sociology, with any discipline that comes in between possible for a particular enquiry. The word 'rehabilitation' can so easily mean all things to all men. Nowadays, because of confusion, there is a wish to discard the word 'rehabilitation', and perhaps replace it with the phrase 'disability management'. In clinical terms this means not only prescription of treatment but of prevention to avoid reduced function. Dependency whether for practical care or emotional support, is the concept usually of greatest importance. 'Handicap management' to reduce social disadvantage is also of relevance but more to social than to medical services.

It is no accident that there has been delay in tackling the problems inherent in these concepts through rehabilitation research. Medicine has had enough difficulty measuring the factors that relate to mortality outcome. The biochemist or the haematologist have readily available a variety of indices that allow them to monitor both the natural history of a disease or its response to treatment. The order of difficulty is very much greater when considering disability outcome. Absolute measures are not readily available to a rehabilitationist. He has usually to rely on some indirect indicant, such as by using a rating scale or by measuring performance of some specified task. The Barthel index (Mahoney & Barthel, 1965) and its modifications (e. g. Granger et al., 1979) are examples of rating scales of functional capabilites, and there are numerous methods of assessing 'activities of daily living' (Sheikh et al., 1979), some specifically designed for study of stroke patients (Holbrook & Skilbeck, 1983). It is important to standardise the measurement of functions like mobility; the twelve-minute walking test has been found to be useful (McGavin et al., 1976).

2. Agreement about assessment methods

The components that comprise quality of living are not easily defined, and may differ among individuals or among cultures. Old outcome measures, such as the proportion of patients discharged from hospital, or the proportion returned to work within a given time, cannot be used nowadays. They are influenced by availability of hospital and community services, or by unemployment rates, so are poor measures for evaluating a treatment programme. Indeed, the outcome measures likely to be best for research about rehabilitation that is community based are by no means obvious. Clinical service that may be appropriate for one patient in the community, may not be appropriate for another, despite comparable disability (WHO, 1976). There can be no absolute standards for success in disability management. Attitudes of patients, relatives, staff, and indeed society itself, can influence measures and certainly most outcomes. But let us not be daunted by the challenge, let us be encouraged by it through understanding better the difficulties and appreciating the reasons for the failings.

Just as agreement on the classification of disease emerged from longstanding clinical practice, so should agreement on disability assessment. Every practitioner of whatever rehabilitation profession should be encouraged to measure and record information relevant to his routine observations and the outcome of his treatment. It is simply not good enough for some kind of nebulous clinical appraisal to be made, and then treatment to be applied without assessing its effectiveness. If willingness to record routine measurements could be more universal, then there should be more interest to obtain agreement about methods for disability assessment. My view is that until the balance of opinion shifts to make such scrutiny routine, it will be difficult to achieve adequate methods for clinical research. To impose a system from outside is insufficient to attract the acceptance of practitioners, and yet in order to make progress such pressure must continue to be applied. Both approaches should have their place whether from the academic or from the clinician, in the hope of meeting with agreement for an acceptable system. Rehabilitation must come of age by recognising that clinical practice should be altered only by application of the conclusions obtained through systematic observation. It could be valuable for training seminars to be readily available, perhaps using videotape techniques. The science of clinimetrics needs to be applied.

3. Reliability and validity

The concepts of reliability and validity should be to the foreground in any consideration of research methodology. It is essential for the repeatability of any measurement to be known. I state this with conviction, and yet I recall my introduction to clinical science as a newly qualified house-physician when I was expected to measure the haemaglobin using a Sahli haemaglobinometer. I was only too well aware how unreliable were my judgements of colour matching, and so it was a relief to me when that method was superseded by one of better repeatability. Yet how easy it is to fall into that trap in rehabilitation research, as almost every study uses a different method, and for which reliability and validity should first have been shown to be adequate. Reliability needs to be established either between separate occasions when no change would be expected, or between separate observers when there should be similar findings.

Whatever is measured must mean what it purports to mean (Stevens, 1946). It is all too easy to make an observation for instance about mobility of a patient in hospital (McGavin et al., 1976), and then to extrapolate that this finding will predict his mobility at home or outside in the street – that may not be so. For instance, physiotherapists may record good mobility of patients with amputation in the gymnasium, while nurses record their mobility to be less in the ward, and that again may differ from how well they perform an objective test of walking speed. Unfortunately in rehabilitation, there is often no absolute criterion by which any observation can be validated. How well a measure predicts what might be expected must be the relevant criterion.

4. Impairment, disability and handicap

The International Classification put forward in 1980 by the World Health Organisation of Impairments, Disabilities, and Handicaps (ICIDH) marked a turning point in our understanding for a fundamental approach to rehabilitation research (WHO, 1980). Unfortunately, the classification itself is cumbersome (Duckworth, 1983), and has turned out to be difficult to apply in clinical practice (Ford, 1984). Why should this be? Perhaps it is because the ICIDH contains lists which were not widely in use, if at all, by those practising rehabilitation in whatever profession. Nevertheless it has been tried out in several countries, and reports are indicative of its value (e. g. Robinson, 1985; Last, 1985).

Instruments can be used in research which require considerable attention to detail, and it may be acceptable to devote a large amount of time for the assessment of a few cases in a study. Such an amount of time would be quite unacceptable in ordinary clinical practice where the patient must be easily classified without disruption of arrangements, and the categories must be readily understood. In a sense the research situation can accommodate a divergent model with numerous categories, whereas clinical practice is more suited to a convergent global rating (Aitken, 1981). It would seem that the most important components are effects of current symptoms, reliance on others, degree of social integration/isolation, and effectiveness (Affleck & McGuire, 1984). As a clinician, I prefer a simple system, believing it is better to rate the problem nearly correctly than not at all in detail. Hence, I do not think that the ICIDH will turn out to be a turning point for clinical use, because of the too detailed classification that is expected. Let us hope that soon it will be simplified.

I do believe that the ICIDH philosophy relating to the consequences of disease has contributed something much more fundamental than simply a classification. Its great value has been to make the clear distinction that disease can produce impairment with separate consequences of disability and of handicap. For that distinction now well acknowledged, acclaim is deserved. It is the assessment and mangement of disability that is of primary importance to the medical services, and to the professions therein involved. Its use can help to study the outcome of comprehensive medical rehabilitation (Granger, 1985).

Fortunately, impairment is usually fairly easy to classify as it relates so much to diagnosis and particular organ involvement. However, it is disability which requires to be better understood in order to improve its treatment and management. There are almost as many different methods as there are researchers making enquiries or even clinicians simply wanting to keep records. It should not be beyond our capability to agree on what aspects should be routinely assessed relating to a particular impairment, and in what way. There ought to be some universal agreement, just as there are many examples of universal agreement about scientific units to be used in various other disciplines. To put forward an assessment scheme for disability, to be used when comparing the benefit of certain kinds of medical services, could be a very worthwhile project for the World Health Organisation.

5. Bio-psycho-social approach

It can be said that many patients who do not have psychological or social problems can rehabilitate themselves. It has been established that the outcome of many rehabilitation programmes can be markedly influenced by socio-economic class, usually indicating that handicap can be worse for those already socially disadvantaged (e. g. Cay et al., 1979).

Likewise, it has been shown that mood disturbance, whether anxiety, depression, or frustration, can influence outcome adversely, and so psychological factors must be taken into account when planning any treatment programme (Aitken, 1984). Inherent in rehabilitation practice should be the principle of holistic medicine, which emphasises the bio-psycho-social approach (Kimball, 1981). Inherent in the requirement for research is the same principle, whereby a study of one aspect must take into account the influence of the others. To do so can shake fundamental beliefs. For instance, I understand that outcome in elderly patients with fractured neck of femur is influenced more by the degree of dementia than by the specific type of orthopaedic hardware inserted. There fortunately are several good standardised schedules for psychological assessment.

6. Comparative studies

All too often the characteristics of one group of patients are reported, when more might have been gained by comparing two groups enrolled with a different criterion. Drug trials have often been a stimulus to define methods, and much has been learned about various disorders from comparative studies, usually on the effects of treatment compared with a placebo. Mortality outcome trials in cancer patients are best when directly comparative.

Sensitive statistical techniques are available to ensure that before there is interpretation of any clinical significance, there is an awareness of the probability that the findings could be attributed to chance. Without statistical significance, little can be concluded about clinical significance, though of course even good statistical significance may not ensure relevance in clinical practice. Patients must always be recruited in a representative manner, so that the results can be extrapolated to a wider group than the sample studied. This may seem obvious, and yet many psychology studies are undertaken on students as subjects, and even on psychology students. There is a false expectation that the results are relevant to the general population, and far less to sick patients. Much research has been done in rehabilitation on the suitability of wheelchairs for young paraplegics. Yet the commoner user of wheelchairs is the elderly patient, where that research may be inapplicable.

It must always be remembered that comprehensive assessment should reflect not only the observations of the researcher, but of the staff responsible for the care of the patient, and sometimes the relatives and the patient himself. Too often, rehabilitation research has neglected that the most important aspect is what the patient himself feels about his treatment programme and outcome achieved. The data from these differing viewpoints must of course be handled as different measures.

Stroke is a condition which has been much studied by comparison of different services, whether on in-patients (Garraway et al., 1980) or on out-patients (Smith et al., 1981), and whether on professional treatment or lay care. Though these studies have usually demonstrated some benefit from specific treatment, it has been of an order not that much more than in a control condition; much of the improvement could be attributed simply to the intensive involvement with the patient or his relative. Indeed reduction of that intensive involvement may have precipitated relapse in independence. Such comparative studies are required in many conditions prone to variable disability, certainly to look at the component parts of treatment.

7. Conclusion

These remarks are restricted to views from a medical perspective. My perspective is as a clinical scientist trying to record the most important measurements – and by measurement I mean "assignment of numerals to things so as to describe facts and conventions about them" – which was the definition of measurement put forward by the British Association for Advancement of Science (Stevens, 1946). The challenge is to bring about the translation from the clinical description to the numerical language. I have always held the view that the clinician needs to converge the many aspects he perceives, if not to a single assessment score like on the visual analogue scale (Aitken, 1969), at least to a small number of entities. As I said before, it is better to be nearly right than to be precisely wrong.

I appreciate that I have said little new or of any fundamental importance. I am taking this line because I believe that there would be more advance if we simply applied universally what we already know about research in disability management, than if we extend into esoteric pastures. High technology will have an obvious place, in particular in the application of electronics. Provision of low technology to large numbers of disabled people in the community may have far greater impact (WHO, 1976), though first it has to be demonstrated that its availability is worthwhile. Such is the message I want to leave with you. Let us study the simple things first, but do so with superb methodology so that fundamental conclusions can be reached. Such should be the priority for the clinician of all rehabilitation professions. In my view, the best rehabilitation research in the foreseeable future from the medical viewpoint, is likely to be based on the most careful clinical observations, whatever they are, relating to disability management.

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Working Groups (parallel groups)

– Monday, 18th November 1985 –

Group 1:
"Critical evaluation of functional improvements in respect of mobility, manual dexterity, activities of daily living"

Chair: Prof. André Storm, Charleroi, Belgium

Mobility

D. Pratt, Derby (United Kingdom)

1. Introduction

Mobility, or rather the lack of it, is one large aspect of rehabilitation of the disabled which poses a multitude of problems. It concerns a large number of people working in the rehabilitation field and is a fundamental aspect of the work of many clinicians, occupational therapists, physiotherapists, orthotists, prosthetists, and rehabilitation officers and engineers. For some people who are affected by problems of mobility, the remedy is the use of mechanical aids, but all to often this is not the answer. Due to the varying aetiology of many mobility problems and the multifactorial effects upon the individual, simple answers are not always available. Thus, it is clear that to detail mobility problems in one short paper is impossible. This paper thus concerns itself with three very different mobility problems and briefly outlines the means of assessment and the solutions, satisfactory or otherwise, offered to the individual.

2. Lower limb orthoses

In this example, children with cerebral palsy are used to illustrate the value of the use of lower limb orthoses. Very often, children with cerebral palsy (CP) can walk in one way or another, perhaps with the aid of a crutch or other assistive device. However, their gait is highly energy-inefficient, thus tiring the child quickly and reducing their range, looks strange, often resulting in unpleasant comments from children, and can often lead to damage to joints and/or ligaments. This latter point eventually results in many of these children having to undergo surgery to correct, realign or otherwise modify their joints and surrounding musculature. It is true that many of these children undergo surgery despite the use of orthoses, and not all surgery can be prevented or delayed by the use of lower limb orthoses. However, it is evident that the use of lower limb orthoses for CP children offers considerable advantages.

The main aim of orthotic management is to provide support for affected joints and to enable the children to walk in a better manner. Better in this context means (a) more energy efficient; (b) with a more 'normal' appearance; and (c) the prevention or delay of joint/ligamentous damage.

As with all therapeutic techniques, there is a right and a wrong way to proceed. The aim of the orthotist is to provide the minimum amount of splinting for any individual. It is no good providing a complete blocking of, say, ankle movement when controlled ankle motion would enable an easier, more natural gait, be more comfortable and produce more beneficial therapeutic effects.

Assessment for lower limb orthoses is a large topic. The procedure used by the author is very similar to that used at the Dundee Limb Fitting Centre, and is based upon a full assessment of joint ranges, muscle powers, sensation, and skin condition, together with a visual analysis of the disability during gait. This visual analysis can be aided by the use of videotaping or by more complicated gait analysis techniques depending upon the facilities available. Only after all of these procedures have been followed and multidisciplinary discussion held, is an orthosis prescribed and made. The assessment of the validity of the orthotic prescription can be made using the same procedures. Details of the types and styles of lower limb orthoses used in this context is not really the remit of this paper. The use of total contact ankle-foot orthoses is predominant (Fig. 1), although the use of the more conventional leather/metal devices (Fig. 2) is still necessary for some situations.

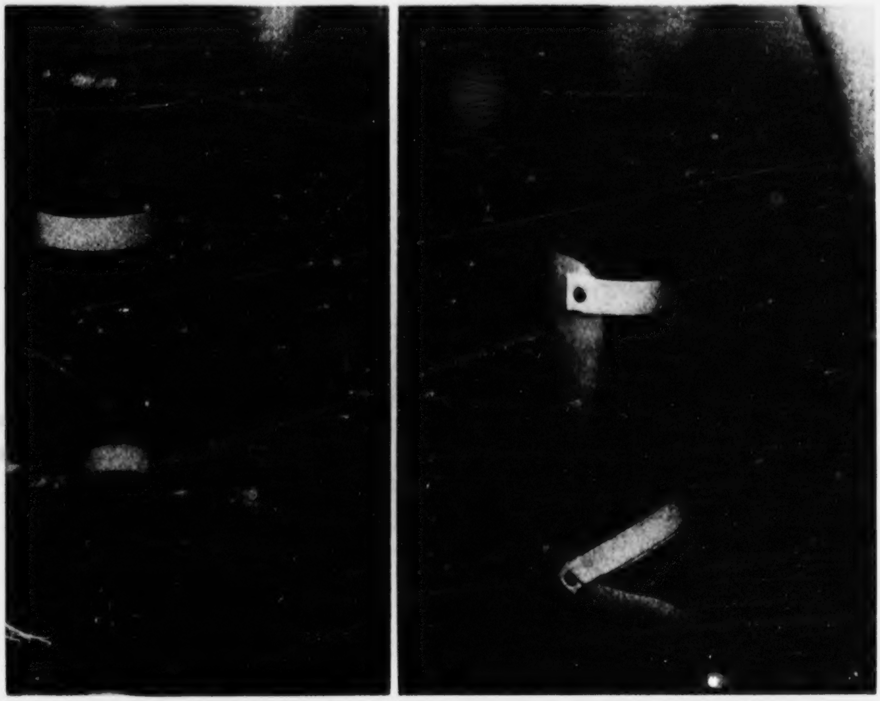

Figure 1: *Illustration of a child with cerebral palsy wearing a total contact ankle foot orthosis viewed (a) anteriorly and (b) laterally.* The latter view shows the knee in hyperextension, which will not occur in use as the pitch of the shoe heel will provide the correct knee angle.

It is not only CP children who can benefit from a coordinated multidisciplinary approach to the prescription of these devices. The list of conditions capable of orthotic management in the manner illustrated includes muscular dystrophy, polio, spina bifida, multiple sclerosis, and, in older patients, hemiplegia, which of course, is not an exhaustive list: in many of these conditions the orthosis prescribed would differ markedly from the types shown in Figures 1 and 2.

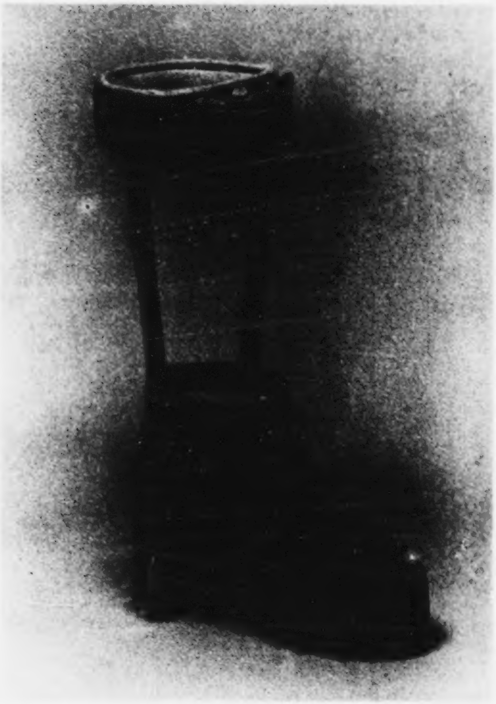

Figure 2: *A conventional double side steel caliper with T-strap and plantarflexion stops.*

3. Hemiplegic rehabilitation

The elderly hemiplegic patients, who may require lower limb orthotic support at some time during their rehabilitation, have to relearn balance and walking prior to the prescription of any orthotic device if appropriate. Many physiotherapeutic techniques are employed to enhance the relearning of balance and walking, and these rely entirely upon the expertise of the therapist and their ability to remember how the patient has performed in the past. The main procedure adopted is termed "proprioceptive neuromuscular facilitation" (PNF), a stimulation of the body's sensory system, and is detailed below. Normally, this is applied as a carefully designed pattern of movements (eg rhythmic stabilisation), which develop, or re-develop, the response of the neuromuscular mechanisms as far as possible. They are used to hasten motor learning by providing appropriate sensory clues and are based upon the knowledge that development or restoration of motor abilities, including the ability to walk, are concomitants of motor learning.

Thus, any method which aids in this motor learning should aid in the return to maximum mobility for that patient. Most of the newer techniques adopted use biofeedback in one form or another. Many systems have been developed which use visual feedback to illustrate to the patient the amount of load shared between the two limbs. The more-or-less equal sharing of lower limb load, and the awareness of this equality, is fundamental to the re-mobilisation of these patients. The visual feedback in its simplest form uses a screen onto which is displayed a picture of their feet and some means of showing the position of their centre-of-pressure (Fig. 3) (a measure of standing symmetry). By using a programme of showing the patient how their centre-of-pressure moves as they move, and how they must stand to produce a

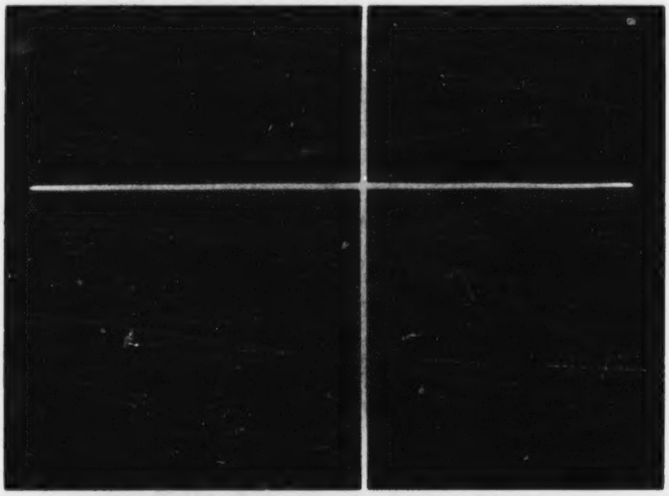

Figure 3: *The screen of a biofeedback balance system showing the position of the patients' feet and the location of the centre of pressure (cross wires on the screen).*

Figure 4: *Prototype biofeedback system used for balance training of hemiplegic patients.* Corrective forces are applied about the centre of gravity of the body.

normal display, the re-learning of balance can be augmented. The use of a cross to indicate the position of the centre of pressure may not be the most appropriate, and systems providing displays of varying types have been tried (eg Nottingham Balance Platform; De Weerdt et al., 1985)). There is some doubt about the value of this technique, and this may be due to either that the basic premise, i. e. that biofeedback is of value, is incorrect, or that a visual clue to balance is not the most appropriate. The use of audible signals for balance training have been tried with a similar degree of success. Perhaps a system whereby tactile feedback is transmitted to the body at the centre of gravity would be more successful (Goodall et al., 1985). This is illustrated in prototype form in Figure 4.

Once the hemiplegic patient has reached a stage of stability, the full potential of their mobility can be realised. As with many rehabilitation problems, the attitude of the patient is a great influence upon the outcome of any therapeutic programme.

4. Disabled driving

Many physically handicapped individuals eventually desire the extra freedom and security offered by being able to drive themselves. It may be that, because of their disability, they will not be allowed to drive a car, but this does not mean that they cannot independently 'drive' themselves around. Self propelled battery operated vehicles are available which are specially designed for the handicapped.

However, the process by which a disabled driver, or potential driver, is assessed for road driving is complex and, in the UK, is slow. Centres like the one in Derby are slowly being created to provide a facility for the assessment of handicapped people for their driving ability, both on and off the road, and the recommendation and fitting of special controls.

First, potential drivers are assessed on a static indoor module (Fig. 5). This unit allows the operator to record the steering force on left and right turns, and the braking reaction time

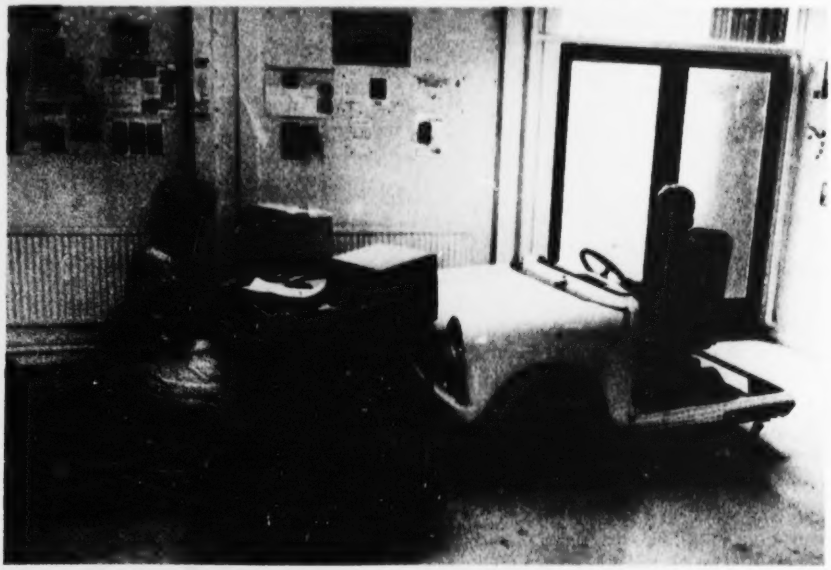

Figure 5: *General view of the Derby Disabled Driver Centre showing the indoor assessment module and the computer used to collect and record the performance data.*

and force in response to a light pattern. The light unit has six lights, any pattern of which can be operator selected, and the driver under assessment has to brake as quickly and as hard as possible when he detects the correct light sequence. The system produces ten correct sequences amongst other incorrect sequences. The test is terminated when the ten correct sequences have been displayed, though not necessarily detected. A report is produced giving the average reaction time, average braking force (with maximum value listed), both with standard deviations, the number of incorrect responses, and any other abnormal responses, such as a double response. This is valuable in that it involves a decision making process instead of just a simple response to a light being 'on' or 'off'. If the driver satisfies the normal criteria during this static test, a road test may be given by a qualified instructor. After this, the correct adaptions for the individual are recommended, and may include any or all of the following: hand controls, power steering, power braking, and electric windows. It may also include adaptions to car seating and the re-siting of electrical switches and control knobs and levers for items such as the choke or heating.

This approach uses a multidisciplinary team to good effect and is proving to be extremely valuable and popular. It also reinforces the obvious value of the multidisciplinary team approach in the rehabilitation field, an approach which has everything to offer to the handicapped individual.

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A clinically viable gait analysis system

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1. Introduction

A Gait Analysis System has been designed, not so much for the bioengineer but more with the medical profession and sports scientists in mind. The system replaces the need for extensive laboratories, high speed cine cameras, force platforms, video recorders, digitizers, film analysers, polarized light goniometers, or any of the many other similar high tech biomechanical tools normally seen in the gait analysis laboratory. Instead, in one package, gait analysis can be performed on patients quickly, easily, efficiently, and provide printout records that can go straight into the patient's notes.

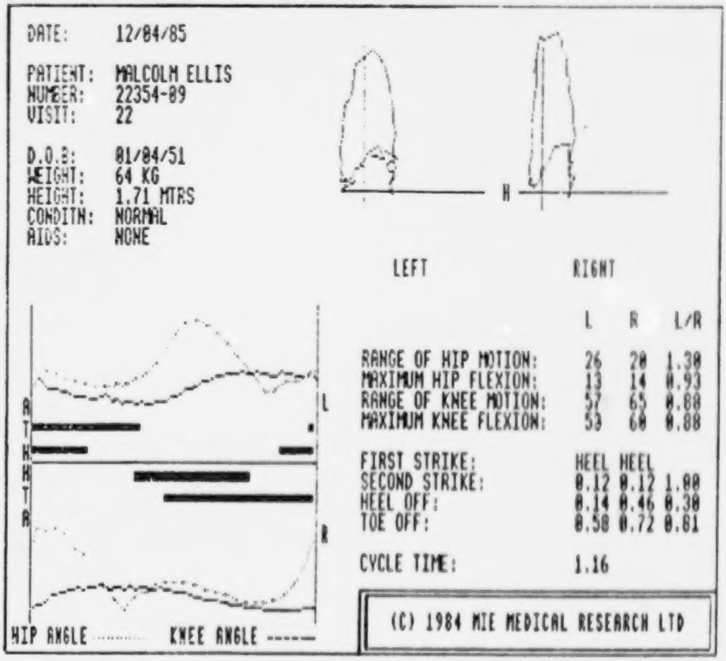
Usually, gait analysis required a specialised gait analysis laboratory. The patient was required to walk on a special walkway whilst being filmed by high speed cine cameras and whilst being monitored by force platforms and EMG recorders. The cine film would then have to be processed and analysed using digitizers, which was a slow and laborious process. More recently, video cameras have been used whereby computers analysed limb movement automatically, but such systems are extremely expensive and give no indication of heel strike or foot contact times. Both systems are not only time consuming but also require a great deal of expertise to operate them. Clinical data was painfully slow to obtain, and therefore gait analysis was restricted to the research institutes.

The new gait analysis system does not require a laboratory; only enough room for a patient to take eight consecutive steps. This could be in a corridor, a physiotherapy department or anywhere in the hospital, and so no special laboratory is required. Anybody can learn to operate the system with only one hour of training by following the simple instructions given in the manual. Most important, however, is the fact that patients can now be tested at the rate of one every 15 minutes, which means that gait analysis is now a clinically viable procedure and no longer the reserve of the research institutes.

2. Description

The Gait Analysis System operates by monitoring hip and knee angle on both legs by the use of electrogoniometers, and also foot contact time by the use of foot switches. These foot switches monitor heel contact time and forefoot contact time. The data is monitored by a telemetry system which is carried by the patient on a hip belt. The data is then transmitted directly to the receiver unit and is fed directly into a computer for real-time analysis. The computer guides the operator through the necessary functions step by step. The operator tells the computer details of the patient, such as height, weight, age etc. This information is fed via the keyboard to the computer. The computer then asks that the electrogoniometers and foot switches be attached to the patient, and the calibration procedure is then initiated. As it is impossible for anyone to place electrogoniometers onto a patient accurately, a system has been developed whereby the operator can place the electrogoniometers quickly onto the patient, and a self-calibration procedure is performed by the computer which ensures correct data acquisition. The computer then asks that the patient stand still, and then that he commence walking. As soon as the computer detects that one foot has left the ground, it assumes that the patient is walking. The computer will do nothing for the first two steps that the patient takes, as it has been proved that the first two steps taken are not typical of normal gait. It is possible to programme the number of steps to be ignored if two steps is insufficient. The computer then collects and analyses the data for the next four steps (or however many is programmed by the operator), averages the information and displays it on a VDU. This data can then be output to a printer, if required. An example of typical data is shown in Figure 1.

As can be seen from Figure 1, the top left hand corner details the patient's biographical data. In the bottom left hand corner, the gait pattern is displayed. The gait pattern is in the form of a graph, the top half representing the right leg, and the lower half representing the left leg. The X axis is displayed as 0–100 % stride cycle, eg. right heel strike through to right heel strike. The curves indicate hip angle and knee angle for both left and right legs, and the bar graph indicates the time that heel contact and toe contact occur. The top right hand quadrant displays Grieve diagrams. These diagrams are a plot of hip angle against knee angle and produce figure of eight diagrams as shown in the sample. These diagrams are extremely useful visual aids for not only comparing left against right leg but also for comparison with previous tests to check small changes in gait pattern. Finally, in the lower right hand quadrant, the actual figures are displayed for both left and right leg, and the ratio of left over right. The cycle time is also displayed. The time taken to do this analysis is usually less than five seconds, most of the time in performing the gait analysis test being due to the placing and removing of the electrogoniometers and foot switches on the patient. Normal printout of the data takes four minutes, during which time the physiotherapist would normally be removing the electrogoniometers, foot switches and transmitter from the patient. Otherwise the data can be stored on disk.



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DATE:       12/04/85

PATIENT:    MALCOLM ELLIS
NUMBER:     22354-09
VISIT:      22

D.O.B:      01/04/51
WEIGHT:     64 KG
HEIGHT:     1.71 MTRS
CONDITN:    NORMAL
AIDS:       NONE

                  LEFT              RIGHT

                                 L     R    L/R

RANGE OF HIP MOTION:            26    20   1.30
MAXIMUM HIP FLEXION:            13    14   0.93
RANGE OF KNEE MOTION:           57    65   0.88
MAXIMUM KNEE FLEXION:           53    60   0.88

FIRST STRIKE:                 HEEL  HEEL
SECOND STRIKE:                0.12  0.12   1.00
HEEL OFF:                     0.14  0.46   0.30
TOE OFF:                      0.58  0.72   0.81

CYCLE TIME:                   1.16

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Figure 1: *Example of Gait Analysis data*

All the clinical data are not new, but well established by many workers in the field of bioengineering. Only the method of obtaining the data and its method of analysis is unique.

The principle of this gait analysis system is based on the work of Gore (1980). He undertook a series of experiments to monitor movement of the hip joint during gait. He used triaxial electrogoniometers to measure hip movement in both left and right legs, and foot switches to measure heel contact and toe contact time. Data were sent via cable to amplifiers and encoders, then onto an FM tape recorder, and finally to a PDP 11 computer. Although the equipment was cumbersome, expensive and time consuming, the data obtained were accurate and of great research value. Gore demonstrated that the data obtained was extremely repeatable. The hip movements in all three planes, as well as heel and toe contact times were within 2 % of average, not only during consecutive steps, but also even if the transducers were removed and replaced and the test repeated again. Gore also showed that the data remained constant after the patient was tested the next day, next week or even next year, providing there was no change in joint function. He also showed that small changes due to disease, physiotherapy or drug therapy could be easily detected. These changes would cause a change in all three planes. Gore tested a number of patients suffering from rheumatoid arthritis, and he was able to demonstrate the changes that occurred due to progress of disease or treatment, be it physiotherapy, drug therapy or surgery. From these data it could be seen that changes in joint function caused changes in range of movement of the joint during walking, and also in the pattern of movement (ie. joint angle versus time graph changes) in both the coronal plane and the transverse plane. However, in the saggital plane, the pattern remains constant and only the amplitude changes with any degree of repeatability. In depth experiments have also been undertaken by Morrison (1968) and Paul (1967). Further studies have been undertaken by Ellis (1982). From these in-depth biomechanical analyses it has been shown that a lot of useful clinical information can be obtained to indicate changes in gait by monitoring flexion and extension of the knee and hip only, and it is not particularly useful to measure joint movement in the coronal or transverse plane.

In order to monitor gait the following criteria must be met:

1. The data must be repeatable. This is ensured by good attachment of the electrogoniometers to the patient and the use of sensitive foot switches.

2. The saggital plane need only be measured for both hip and knee joint, thereby simplifying the data required and subsequently their analysis.

3. Sensitivity of changes in gait pattern must be good. This is ensured by the accuracy of the system and the fact that patients walk with remarkable repeatability in their gait patterns.

To ensure good repeatability, the pattern is expressed not as range of movement of the joint against time but as range of movement against 0–100 % stride cycle. By using this method, small variations in the speed of walking in the patient are overcome.

Similar data have also been obtained by this method for patients climbing stairs, getting in and out of chairs, ascending and descending ramps as well as in normal ambulation.

The gait analysis system is a new method of obtaining these gait data by telemetric methods, which ensure quick, simple and yet reliable results. The electrogoniometers and foot switches are simple and easy to operate, and as they connect directly into the transmitter unit there is no need for trailing wires or any need for a special gait analysis laboratory, as would be the case when using such systems as cine film analysis, video systems or polarised light goniometric systems. Information is fed via the telemetry system directly to the computer so that real time analysis can be performed, and the information is presented to the operator immediately. If for any reason the analysis is not satisfactory, the patient can be asked to repeat the test immediately and will not have to be recalled to the hospital for retesting. No expertise is required to operate the system, so no extra staffing costs will be incurred. Most important, though, is that a complete gait analysis can be performed in under 15 minutes, whereas in the past, using traditional cine film techniques, analysis would take approximately two days and therefore was of no practical use in clinical situations.

The gait analysis system is now commercially available from MIE Medical Research Ltd., of 6 Wortley Moor Road, Leeds LS12 4JF.

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Energy costs of wheelchair propulsion by elderly and disabled people

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1. Introduction

Wheelchair performance depends on the design of the chair, the environment in which it is being used and the capabilities and limitation of the person propelling the chair. The efficiency of wheelchair propulsion, i. e. the ratio of power required to metabolic cost expressed as a percentage, varies from 5 % for an untrained person propelling a standard wheelchair on a carpet to 20 % for a trained wheelchair athlete in a specially designed chair (Brubaker, 1982). The energy costs of wheelchair propulsion have been studied extensively in fit, young patients, particularly paraplegics, but only a few studies have been undertaken on the elderly and severely disabled patients who form the majority of wheelchair users in Great Britain. I shall attempt to summarise some of the factors determining the energy costs of wheelchair propulsion, examine the methods used for assessing these energy costs and discuss the relevance of these studies to the everyday use of wheelchairs, particularly by the more disabled user.

2. Wheelchairs

The weight of the wheelchair is the most obvious factor determining performance, but this is relatively small compared to the combined weight of chair plus occupant. The most important design features include the rolling resistance and the drive mechanism. The tyres are the main determinant of rolling resistance. Pneumatic tyres at a pressure of 45 psi provide least resistance; slight "flatness" of the tyre results in dramatic reduction in performance. The size, position and surface of castor wheels are also relevant. At high speeds, important only in wheelchair racing, castor wheels may shimmy, and this can be reduced by improvements in castor tyre design (Kauzlarich et al., 1984).

Most wheelchairs are of the standard design with large rear propellling wheels. Although less energy efficient than lever or arm crank (Smith et al., 1983) propulsion, wheelchairs with conventional handrims are versatile and manouevrable. The size of the propelling wheels, their position relative to the seat, and the ratio of propelling rims to overall wheel diameter are optimised in sports chairs. The fundamental problem with handrim propulsion is that power is transmitted in only half of the stroke. In lever and arm crank chairs power is transmitted throughout the stroke cycle. Engel and Henze (1985), comparing lever and handrim propulsion, have shown that the efficiency increases with speed, but there are variations between models of lever propelled chair.

Finally, let us not forget the role of attendants in wheelchair propulsion. The relative height and position of the handles is an important, but neglected area of wheelchair design (Hughes & Abel, 1984).

3. Environment

It is fairly obvious that climbing a gradient requires extra work. The effort of propelling on a carpeted surface is also substantially greater than on a smooth surface (Waters et al., 1978; Glaser et al., 1981).

4. Clinical aspects

Sawka et al (1981) showed that cardiorespiratory reserve diminishes more slowly with age than does muscle strength. We have confirmed the validity of this observation, although the clinical significance of it is less than might be imagined in that people compensate for their deficiencies, usually by going more slowly. This is of particular interest in Great Britain because the elderly comprise over half the wheelchair users and 60 % of new referrals to the service (Hunter, 1985). Stroke is the single most common diagnosis in 25 % of referrals, arthritis in 16 %, amputation in 8 %, and para- and tetraplegia in only 6 %. Only 10 % of wheelchair users are truly wheelchair independent. Three quarters are able to walk at least short distances and prefer to do so in their own home, but they use their wheelchairs outside, usually propelled by an attendant.

5. Assessment of energy costs of wheelchair propulsion

The energy costs of propelling a wheelchair are usually studied using standard procedures, either on a treadmill (Hildebrandt et al., 1970; Engel & Hildebrandt, 1973; Glass & Camp, 1979; Crews et al., 1982; Horvat, 1984) or wheelchair ergometer (Brattgard et al., 1970; Stoboy et al., 1971; Wicks et al., 1977; Hjeltner, 1977; Glaser et al, 1979; Glaser et al. 1980; Sawka et al., 1980; Sawka et al., 1981; Brearley, 1983; Wicks et al., 1983; Coutts, 1984; Whiting et al., 1984) but these artificially imposed conditions can present difficulties for many disabled people, and data from performance on them may not reflect their true clinical status.

Even measurements on tracks at pre-determined speeds (Glaser & Collins, 1981; Glaser et al., 1981; Glaser, 1983; Smith et al., 1983) may also give misleading information on a disabled person's customary performance, although they are satisfactory for studying groups of patients.

6. Standardised measures

The parameters which are usually measured include weight, distance, time, oxygen uptake (VO_2), carbon dioxide output (VCO_2), gas exchange ratio (R), expired minute ventilation (VE), pulse rate, and blood pressure. Valid conclusions can be drawn particularly from respiratory tests such as VO_2, VCO_2, VE, and R only when the subject is in a steady state, usually after more than 4 minutes at one speed. Maximum VO_2 during lower limb exercise is greater than with upper limb propulsion. At the same rate of oxygen uptake, the heart rate for upper limb exercise is higher than for lower extremity exercise.

Various measures have been derived from these fundamental measures, but have not been applied universally, e.g. "net locomotive energy consumption", the difference between energy expenditure during exercise and rest divided by body weight times distance covered (Glaser et al., 1981). Measurements of total energy expenditure per unit time are an indication of the burden on the cardiorespiratory system; when analysing mechanical efficiency on the other hand, energy expenditure per unit distance is a more appropriate measure (Grimby, 1983.) This point is not merely academic, but is put into sharp focus by some of the real facts of wheelchair utilisation. Stubbins (1977) coined the phrase "The lived world of disabled persons", and pointed out that the most relevant studies were ones which observed, but did not intrude on, the everyday activities of disabled people.

For people in wheelchairs, propulsion indoors usually involves having to overcome substantial inertial forces to travel short distances on various surfaces, such as carpets each with a different resistance; negotiating through doors and past furniture adds considerable steering effort. Under these circumstances a steady state equilibrium, suitable for truly objective measurements of energy consumption, is simply not obtainable.

Another clinically relevant example is wheelchair propulsion by hemiplegics. One-armed drive wheelchairs are available, either with double handrim or with lever propulsion. Most hemiplegic patients, however, do not use a one-armed drive wheelchair, but instead use their good arm and good leg to paddle along at a slow speed. We are at the moment comparing these methods of propulsion at speeds typical of hemiplegic propulsion in a hospital ward on a modified treadmill, but in order to do this we have had to limit movement of one castor so that the patient is not thrown off. In these circumstances there is no appreciable difference between the two methods of propulsion when a steady state has been reached. In real life, however, it is very much easier for a hemiplegic patient to propel and steer with combined arm/leg movement than to use a one-armed drive wheelchair; it also requires less concentration. It is, therefore, the preferred method. Waters et al. (1978) showed that this form of hemiplegic mobility was more energy efficient than walking with a spastic gait, although it is only one of many factors which will determine what method of mobility a stroke patient may employ.

For outdoor propulsion, the problems faced by a disabled person in a wheelchair are somewhat different, including kerbs, the camber on roads, and irregular or potholed surfaces. I have already stressed, however, that most wheelchairs are in fact propelled by an attendant when they are used out of doors.

In Edinburgh, a high proportion of people live in tenement flats, and many others have steps to negotiate. Consider the problem of an attendant pulling a disabled person in his wheelchair up and down two 4-inch steps. In the first example illustrated at the conference with the patient in an attendant style propelled chair (with small rear wheels), the attendant's pulse rate went up by an average of 30 %. If the disabled person was in a self-propelling style chair, with large rear wheels, the effort which the attendant had to apply to get him up the steps only increased his heart rate by 20 %. There are fairly obvious ergonomic reasons why this should be so; it is also worth commenting that if the tyres of the self-propelled chair with large rear wheels were flat, more effort was required than when pulling the attendant type chair with fully inflated tyres up the steps.

People usually compensate for their difficulties in walking or propelling a chair by going more slowly (Williams et al., 1983). Thus, energy expenditure per minute may be similar for disabled and non-disabled groups performing the same task, but the energy expenditure per metre covered, or per task completed, is usually greater in the disabled population (Grimby, 1983). Each person performs a task, for example walking, or propelling or pushing a wheelchair, at a preferred speed; below that speed the pulse rate rises and above it it also increases. Self-selected velocities for wheelchair propulsion and walking are related to both maximal physical capability for each activity and locomotor efficiency (Glaser et al., 1983). Measurement of pulse rate changes are easy to perform and may be monitored and recorded unobtrusively. The physiological cost index (average pulse during exercise minus the average at rest divided by speed, expressed as beats per metre; McGregor, 1979) is an empirically valid index of energy cost, which may be one means of overcoming some of the practical problems of assessing energy costs of wheelchair propulsion by elderly and severely disabled people in their own environment. We should also devote more attention to the effort expended by attendants.

7. Conclusions

It is desirable to perform standardised physiological tests on patients and attendants propelling a wheelchair whenever possible, and these are essential for studies relating energy aspects to wheelchair design. They are, however, not always obtainable with many elderly and severely disabled people because of the need to obtain a steady state. More attention should be focused on the effort of wheelchair propulsion in real life situations by the widest possible range of wheelchair users. Unobtrusive measurements of pulse rate and physiological cost index appear to be the practical way to resolve some of these difficulties. Studies on the energy costs of attendant propulsion in standardised and real life situations are also required.

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Evaluation of hand movements used during hand testing and activities of daily living

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The Jebsen Test of Hand Function (JTHF) (Jebsen, 1973) was developed in 1969 in the United States to allow for a method of objectively measuring patients' hand function. The test was designed so that hand movements used by the subjects to complete the test would be those commonly used in Activities of Daily Living (ADL). The test was also meant to be sensitive to deficit (e. g. muscle weakness, tremor, sensory loss) and to change in the patients' condition over time. The test originally consisted of 7 subtests: writing a sentence, turning over cards, picking up small objects, a simulated feeding task, stacking draughts and picking up large light and large heavy objects. Two subtests have been added, tracing through a maze and assembling nuts and bolts. All subtests are done with both the dominant and nondominant hands. The time taken to complete each task is recorded, and this time acts as a score.

In a recent study at the National Hospital for Nervous Diseases, London, the usefulness of the test with neurological patients was evaluated. Part of the evaluation of test validity included a study of hand movements used by normals and patients during the hand test and feeding and dressing (shirt only). 25 normal subjects and 25 patients were used in this part of the study. Patient diagnoses included such conditions as Multiple Sclerosis, Parkinson's Disease, and myopathies.

The subjects were videoed performing the JTHF and feeding and dressing. Hand movements used were then analysed in two ways. The first method was according to what grip type was used. These grips included pulp pinch, lateral pinch, tripod pinch, five-finger pinch, diagonal volar grip, transverse volar grip, spherical volar grip, and extension grip (see Fig. 1). The second method used was that developed by Sollerman, 1976. In this method, freeze frame video analysis was used – that is, the hand movement used by the subject was "frozen" at a preselected point in time of each task. It was then examined according to the position of the metacarpals, proximal and distal interphalangeal joints of each finger, the contact of each finger (opposition, used, not used, supportive), and the placement of the object in the hand (see Fig. 2). The two types of analysis were repeated for each subject at many points in the tasks. Three points in time were analysed in the performance of each of the tasks in the hand test, and multiple points were chosen in the feeding and dressing – 172 points in time in all.

Normal subjects used were performing the tasks within the time limit for their age group. Patient subjects could perform all tasks, but were slow or outside of the normal range of time for task performance. It was felt that the information found during the analysis may help to determine if the grip type used by the subject affected the time of task performance.

It was found that the movements used by normal subjects varied tremendously – both in the hand test and ADL tasks. The position of the MCP's, PIP's and DIP's vary between subjects, the position of, e. g., a pen or knife varies, and the fingers used to complete the task also vary. Because of this variation not only between normal subjects, but also within tasks performed by an individual, it was felt best not to continue and attempt to analyse patient hand movements. It was felt that any variations which may have occured could not be isolated from a normal grip.

From our findings, it was possible to identify common types of hand grips – but no "norm" was found. It would appear then, that a wide range of grips are used during testing and ADL. This variation occurred between subjects and within one subjects's grips. The normal

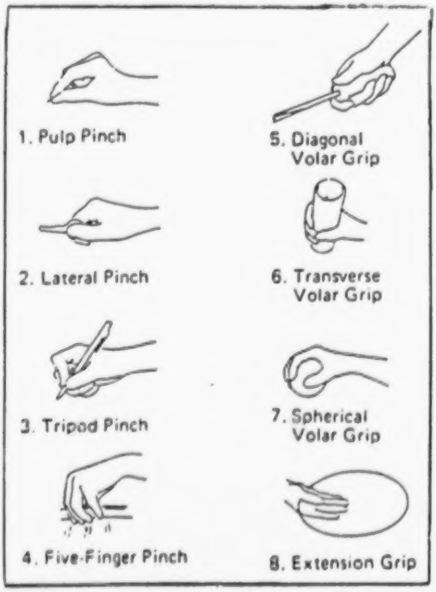

Figure 1: *Hand Movement Analysis – types of grip.* (Reproduced with kind permission of C. Sollerman, Goteburg, Sweden).

Griffiths	Cylinder grip
Herig	"Faustgriff" Whole-hand grip
McBride	Whole-hand grip
Napier	Power grip, cylindrical
Landsmeer	Power grip, nonmanipulative prehension, cylindrical
Univ. of Iowa	Power grip, nonmanipulative prehension
Maul/Soll	"Faust / Umfassung"

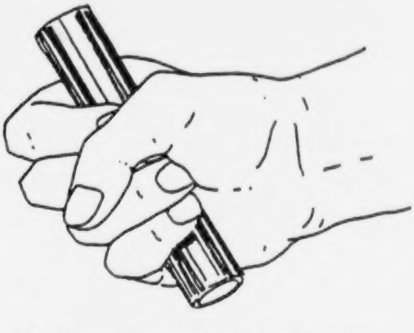

Figure 2: *Hand Movement Analysis Method developed by Sollerman (1976).*

subjects – irrespective of the grip used – remained within a normal score range. For the patient population, the JTHF performance was slow, and all ADL tasks were completed. It may well be concluded that grip, per se, is not the primary problem with performance of these tasks. We were unable to accept the hypothesis that the JTHF used grips commonly used in ADL – as it was felt that this was due to a large element of chance. Hand grip (as used in the JTHF) does not therefore appear to be an accurate predictor of ADL performance.

In conclusion – commonly accepted classifications of grips do not appear to apply when the hand is being used dynamically. When working with patients who have central nervous system involvement, one may wish to question the usefulness of evaluating the patients ability to perfom a task using "normal" grips when: a) there does not appear to be a normal, b) these grips change frequently and rapidly during task performance, and c) grip type used does not appear to affect the subject's ability to complete the task in a normal range.

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Restoration of grasping functions in quadriplegic patients by Functional Electrical Stimulation (FES)

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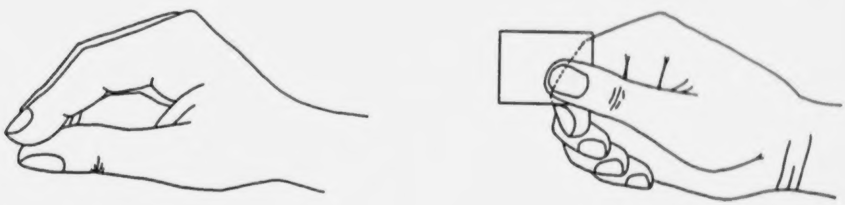
An action potential can be elicited in the peripheral nerve that is indistinguishable from any action potential evoked by physiological mechanisms [11]. The response of the end organ, the muscle contraction, is identical in both situations. By coordinated stimulation of peripheral nerves and muscles, "natural" movements can be synthesized. This method of Functional Electrical Stimulation (FES), developed in the last 20 years, can therefore substitute for some central mechanisms in patients with central motor lesions who have intact peripheral nerves and muscles. Although today's FES systems are still in the first stages of clinical application, the method has the potential to be beneficial for thousands of patients who are severely handicapped by central motor lesions. Recent developments in microelectronics, materials research, neurophysiology and other related areas gave new impulses to neuroprosthetics research and resulted in the development of small microprocessor-controlled multichannel-stimulators [5, 6, 13, 18, 19].

Clinical research and application is focused on two main targets, the restoration of grasping functions in quadriplegic patients [11–13], and the restoration of posture and gait in paraplegic patients [1–4, 6–10, 16–18].

This paper aims at summarizing the principles of FES in the restoration of grasping functions in C 5/C 6 spinal cord injured patients, as they have been developed at the Rehabilitation Engineering Center in Cleveland over the last 15 years [10–15].

Restoration of grasping functions in quadriplegic patients is particularly important because the patients are almost always paralysed in both arms and unable to manipulate any object in everyday life although they can place their arm in space by shoulder movements and elbow flexion. Two grasping modes, the palmar and the lateral prehension, were attempted (Figure 1) in 30 subjects over the last years. Palmar prehension (with the thumb in abduction opposite to the index and the middle finger) is used to pick up small objects or to hold larger objects like a cup. Lateral prehension (or key grip) is used to firmly hold small objects like pencils, tooth brush, and other utensils of daily living activities.



Palmar prehension

Lateral prehension

finger flexors (flexor digitorum superficialis)
lumbricales
finger extensors (extensor digitorum communis)
thumb abductor
thumb extensor (extensor pollicis longus)

thumb and finger extensors (extensor pollicis longus, extensor digitorum communis)
finger flexors (extensor digitorum profundus)
thumb adductor
thumb flexor (flexor pollicis brevis)

Figure 1: *Palmar prehension and lateral prehension, with the muscles essential for restoration of both grasping modes listed below.*

Patients accepted for the program were selected according to the following criteria:

(a) Complete spinal cord injury at the level of C 5/C 6

(b) At least one year had passed since the injury had occured

(c) Patients who were no candidates for surgical reconstruction of the hand (tendon transfer) because they had insufficient voluntary muscle force

(d) The peripheral nerves for the hand muscles were intact

(e) Spasticity was mild or moderate and no major contractures or other complications were present

(f) Patients and their families were motivated to enter the treatment program and had realistic expectations

(g) Patients were living nearby so that frequent follow-up examinations and scientific evaluation were feasible

FES is essentially an "electronic bypass" of the injured spinal pathways, as is demonstrated in Figure 2. A command signal (CS) that can still be generated by the patient, i. e. a shoulder movement, is picked up by a transducer and transformed so that an appropriate stimulus pattern is generated in the multiple channels of the stimulator.

Contraction of the muscle in FES is achieved by electrical excitation of the muscle. Since the threshold of peripheral nerve fibers is much lower than that of muscle fibers, an electrical stimulus always elicits an action potential in the nerve. Only with very high stimulus intensities, muscle fibers are directly activated [11, 15]. Stimulation could be performed via surface electrodes, nerve cuff, or intramuscular wire electrodes. For restoration of precise grasping movements, intramuscular percutaneous wire electrodes were chosen because they induced repeatable and stable contractions.

Coiled wire electrodes were introduced with a hypodermic needle into the muscles to be stimulated. Up to nine muscles were activated by seperate indwelling electrodes, which penetrated the skin usually at the volar or dorsal surface of the forearm. Different sets of muscles have to be activated for the palmar prehension and for the lateral prehension (see Figure 1). The precise location of each electrode varied, and was checked by passing current through the wire during insertion. The penetration sites were protected by plastic caps and connectors taped to the skin surface. This mechanical protection, and regular cleaning of the penetration site, prevented infections and other adverse reactions. The material of the wire electrode consists of stainless steel (type 316 L) and is electrically isolated by a teflon coating.

Several weeks after implantation of these chronically indwelling electrodes, a stimulation program for exercise of the muscles was begun in order to increase strength and endurance. This electrical training was continued for approximately two months and resulted in a change of muscle properties. By chronical stimulation, phasic muscle fibers are transformed into tonic ones, which are less prone to fatigue. In addition to the increased fatigue resistance, electrically exercised muscles have slower contraction times and therefore allow sufficiently fused and smooth contractions at lower stimulus frequencies.

After the electrical training, the mechanical and electrical properties of the stimulated muscles are determined, i. e. the threshold, recruitment curve, fatigue, length dependence of force development. The modulation of contraction force is done either by increasing the stimulus strength and thereby recruiting additional muscle fibers, or by temporal summation. In order to keep fatigue at a minimum, the lowest possible stimulus frequency is employed (around 15 Hz), and contraction force is increased by increasing stimulus pulse width. Stimulus frequency is increased only for high contraction forces.

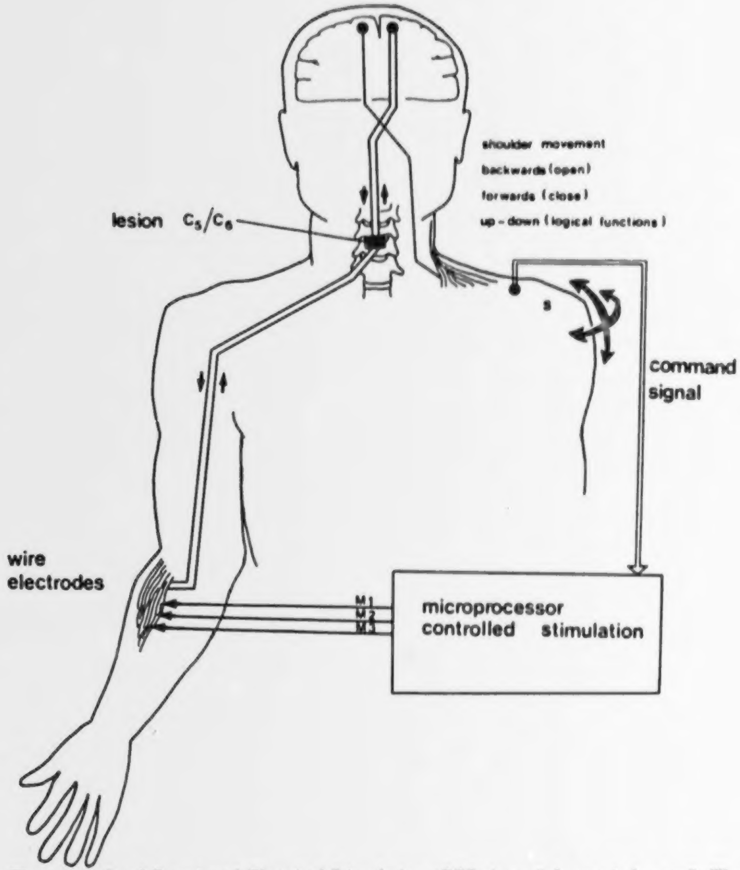

shoulder movement
backwards (open)
forwards (close)
up - down (logical functions)
lesion C_5/C_6
S
command signal
wire electrodes
M1
M2
M3
microprocessor controlled stimulation

Figure 2: *The principle of Functional Electrical Stimulation (FES) is an "electronic bypass". The spinal cord is lesioned at the level C 5/C 6, causing sensorimotor paralysis below that level. A control signal (S) produced by shoulder movements in forward-backward direction is fed into a multichannel microprocessor-controlled stimulator. In this stimulator, stored muscle properties and the coordination scheme are translated into an appropriate pattern of stimuli. These stimuli are delivered via several implanted wire electrodes to the paralysed muscles. Elevation-depression of the shoulder activates logical functions, i. e. "freezing" of a particular position, or switching from lateral prehension to palmar prehension.*

The electrophysiological and biomechanical data of each stimulated muscle are used to establish a "coordination scheme" for the palmar and lateral prehension. Coordination between the different channels of the multichannel stimulator is achieved by specifying, for each individual channel, the stimulus strength, stimulus frequency for a certain input command. This method provides each muscle with the proper information when and how much to contract at a certain time, and allows to activate muscles as synergists and antagonists. The coordination scheme is stored on a programmable microprocessor (EPROM-chip) in the form of look-up tables, so that during the "synthetic" grasping movements the stimulus parameters and the stimulation pattern are calculated by this algorithm.

Command signal and coordination scheme have to be adapted to the abilities and requirements of the patients. Both with palmar prehension and with lateral prehension, a shoulder movemet in the forward direction caused a closing of the grip, whereas backward movement of the shoulder caused an opening or release. Usually patients learned within a few sessions to use the system so that smooth grasping movements resulted. Elevation – depression of the shoulder activated "logical functions", i. e. freezing of a particular position, or switching from lateral to palmar prehension.

Since C 5/C 6 patients have no sensation, they have to rely only on visual input for their synthetic grasping movements. Almost all FES systems currently applied are open loop systems, i. e. the patient has only visual feedback of the movement result. Therefore constant attention is necessary. In spite of these limitations, patients learn to apply appropriate forces so that they are able to hold paper cups and other compliant objects. They gain independence in their daily living activities, and several of them are continuing their jobs as engineer or computer programmer.

Closed loop systems would result in more accurate movements. Therefore attempts have recently been made to develop FES systems with sensor feedback. In addition, fully implantable stimulators are under development and have already passed animal tests. It therefore seems that in the next years FES will gain broader clinical application, although only in combination with classical methods of rehabilitation.

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A critical evaluation of car seat belts for disabled people: the problems of upper limb mobility and manual dexterity

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In 1983, legislation was passed in the United Kingdom making the wearing of front seat belts compulsory. A project funded by the Department of Health and Social Security under the Aids Assessment Programme, was conducted to evaluate the aids and adaptions available to make seat belt wearing easier or more comfortable for disabled people.

A survey of 100 disabled people with rheumatoid arthritis (50), ankylosing spondylitis (25), osteoarthritis (17), and neurological conditions including multiple sclerosis and spastic diplegia (8) showed that the greatest problem, which was reported by 78 % of the subjects, was difficulty reaching the stowed belt. Fastening the buckle caused problems for 55 %, and in most cases this was attributed to difficulty reaching the stalk.

Discomfort associated with seat belt wearing was reported by 50 % of the subjects, mainly in the shoulder region of people with arthritis and across the chest of subjects suffering from ankylosing spondylitis. No one buckle type was found to be consistently difficult to fasten, but generally subjects found the buckles mounted on fixed housings or short stalks easier to use, provided they could reach them. Subjects with poor coordination reported that buckles with deep troughs made location of the tongue easier as the angle of presentation was less critical. Many of the subjects who were under 5' 4" tall complained that the seat belt cut across the side of the neck. Concern was expressed by many disabled people that they would not be able to unfasten a belt in the event of an accident, although evidence suggests that wearing of the seat belt reduces the risk of serious injury and therefore increases the chances of escaping from a vehicle.

Evaluation of replacement belts, comfort clips, reaching devices, and drop links were carried out by groups of disabled people suffering from rheumatoid arthritis, ankylosing spondylitis, osteoarthritis and multiple sclerosis who experienced difficulties with seat belt wearing.

Three replacement belts with both inertia and static mechanisms, and various buckle designs were tested. The selection of an inertia or static belt is a matter of individual preference, but most of the subjects preferred a static belt because some slack could be introduced to increase comfort and there was no resistance from the belt when pushing the tongue into the buckle. It should be noted, however, that in our survey 50 % of the disabled people experienced difficulty adjusting the tightness of a static belt. The disadvantages of static belts were that there is little freedom of movement if the belts are correctly adjusted and the belts do not stow automatically. Inertia belts have the advantage of being self adjusting and allowing greater freedom of movement, which is an important consideration for people who experience stiffness after sitting in one position for long periods of time, such as ankylosing spondylitis sufferers. However, inertia seat belts with high retraction forces may be uncomfortable, more difficult to fasten and awkward to remove.

When considering the various buckle designs, most subjects found the Britax buckle easiest to operate, as the release button was situated on the top and could therefore be depressed by the thumb, finger or knuckle. The magnetic Kangol buckle was also found to be very easy to fasten and unfasten, although it does not satisfy the EEC regulation requirements because it cannot be fastened using one hand, and when fastened the buckle lies over the abdomen.

Four comfort clips, which are designed to increase the comfort of inertia belts by preventing full retraction of the belts, were also tested. Results showed that although most of the subjects felt that the clips were effective in increasing comfort, none of them were fitted within the generally accepted safety limits of 5 cm slack. As chest injuries can occur as a result of seat belts being worn too loosely, we would not recommend the use of these devices by disabled people until further safety tests have been conducted.

Two reaching devices, which comprised of a stiffened webbing strap which sticks into the seat belt with adhesive (Easy Reach) or length of plastic which clips onto the belt (Pulla Belt), enabled all the subjects to reach the stowed belt more easily, thereby overcoming the greatest problem identified in the survey. It was considered to be an advantage if the position of the device could be altered if necessary, or moved from one belt to another, as is the case with the Pulla Belt.

The drop links which lowered the upper anchorage point of the seat belt by several centimetres were found to be very useful in cases where the belt cut across the side of the driver's or passenger's neck. One device was considered to be potentially dangerous as it fastened onto the diagonal strap of the belt and in the event of an accident could introduce some slack.

In conclusion, many of the problems associated with seat belt wearing can be solved by provision of a suitable adaption, but it is important that these devices are fitted correctly and do not interfere with the operation of the belt.

Functional measurements in the hands of patients with rheumatoid arthritis

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1.0 Introduction

In the treatment of diseases such as rheumatoid arthritis, and following surgical intervention, it is important to have an accurate measurement of the patient's hand function. Such a measurement should enable clinicians and therapists to assess the response of the patient to the treatment or to gauge the progression of the disease.

Such an assessment routine needs to be accurate, quiet, reproducible, and simple to use. With these assets, meaningful results would be obtained without causing fatigue or inconvenience for the patient.

While many hand assessment systems or routines have been published (Carthum et al., 1969; MacBain, 1970; Kellar et al., 1971; Clawson et al., 1971; Smith, 1973; Peskett, 1973, 1977; Bell et al., 1976; Walker et al., 1978) none has gained widespread acceptance. The majority have the disadvantage that they are highly subjective and concentrate on assessing the ability of patients to perform activities of daily living (ADL). Problems can however arise in determining the level of patient achievement, as all that can be established is success or failure in performance of the task. Thus a patient who just fails to perform one of the assessment functions is given the same grade as one who fails by a wide margin.

Attempts at objectivity have been made, often by measuring grip strength with a rolled up or folded sphygmomanometer cuff. This is inflated so that when gripped a pressure rise is recorded (Wright & Plunkett, 1966; Ansell, 1969; Carthum et al., 1969; MacBain, 1970; Clawson et al., 1971; Cantrell, 1975). The primary disadvantage of this system is that it actually measures a pressure rise (which is force per unit area). The force required to give this pressure rise is proportioned to the area of contact. Therefore a large hand needs to exert a higher force than a small hand to obtain the same pressure rise. The same error can also be introduced by different techniques of gripping. A person who grips with the fingertips will produce a much higher pressure rise than a person whose fingers are in full contact with the cuff. These disadvantages are inherent to inflated cuffs even though transducers have been attached to update them (Myers et al., 1979; Pearson et al., 1982).

Although other devices have been available since the introduction of the "Jamar" dynamometer (Bechtol, 1954), the inflated cuff has remained popular. Strain gauges however have recently been used, with increasing regularity, since the work of Walker et al. (1978). However, the majority of these devices have only been used in grip studies and have not been included in full assessment routines.

A great disadvantage of most functional assessments is that they are highly complex and time consuming because the patients are required to perform many ADL tasks. Thus patient fatigue becomes a prime consideration during the assessment.

From this background it is evident that there is a need to develop an automatic hand assessment system that will be simple and quick to use by non-technical staff, robust, reliable, and which will provide results for immediate evaluation by the clinician or researcher.

2.0 Apparatus

The apparatus used is shown in Figure 1 and can be divided into three primary parts: the measuring devices, the electronic circuitry, the computer.

Essentially, the measuring devices contained three isometric hand force measurements and two ADLs that had transducers added to measure the forces exerted during their action. Fourteen transducers were included, in strain gauged cantilevers.

These needed to be conditioned and selected at the right moment, their outputs amplified and results displayed. An Apple II microcomputer controlled all these devices as well as calculating, displaying and storing the results.

2.1 Measuring devices

2.1.1 "Power" grip and finger force measurement (Fig. 2)

Applied finger force was measured by four transducers rigidly bonded to the cantilevers main body. "Power" grip was the sum of the four individual finger forces. Each finger button was saddle-shaped and free to rotate for comfort and to accommodate some finger deformity. The heel plate was shaped to fit comfortably in the palm of the hand. The keyboard to heel plate distance was adjustable in 13 mm steps.

Figure 1: *General view of complete assessment system*

2.1.2 Pan and kettle handle grip measurement (Fig. 3)

Handle grip was measured by installing a transducer into a handle, externally shaped as a typical pan handle attached to a milk pan. One side of the handle was free to move in linear bearings against the transducers.

Similarly, a transducer was installed in a typical kettle handle fastened above the milk pan. This enabled the same lifting force transducers to be utilised (paragraph 2. 1. 3). To ensure that the grip force was isolated from the lifting force the operating surface of the transducer was on the top face. Thus was free to move, in roller bearings against the transducer.

2.1.3 Pan and kettle lifting force measurement (Fig. 4)

Two transducers were utilised. One was clamped parallel to the pan base and the other was clamped to the rigid frame of the test unit. These were connected by a twin rate spring that limited the lifting movement over a large range of lifting force. A low rate spring provided a small pan movement for weak patients. Its movement was limited, and a stronger spring took over for stronger patients and healthy subjects.

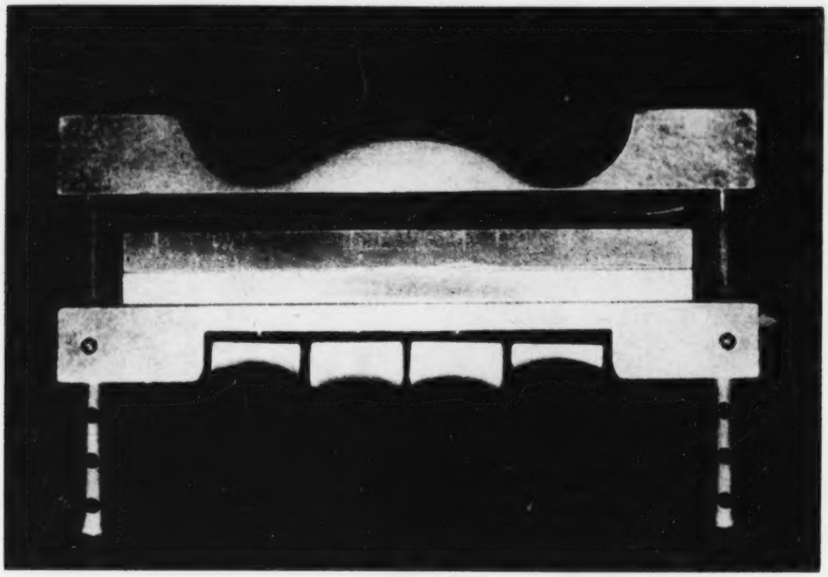

Figure 2: *"Power" grip transducer*

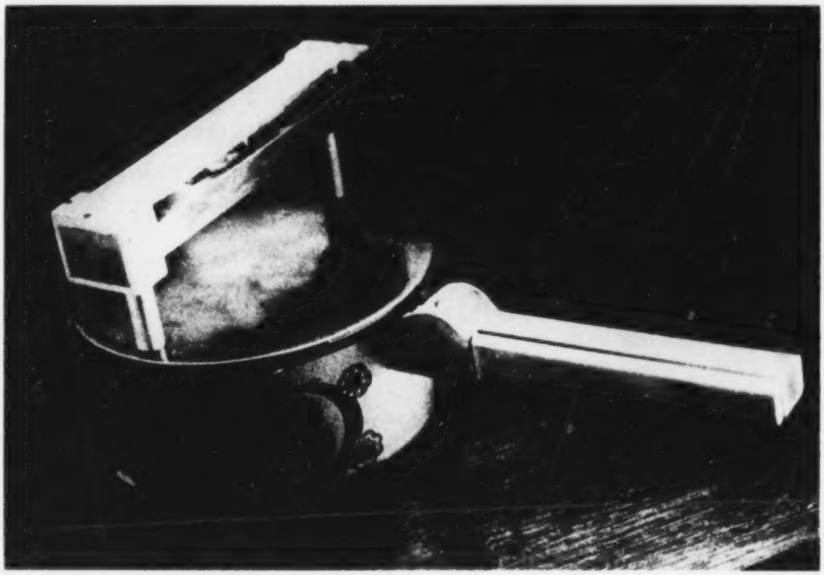

Figure 3: *Pan and kettle transducer*

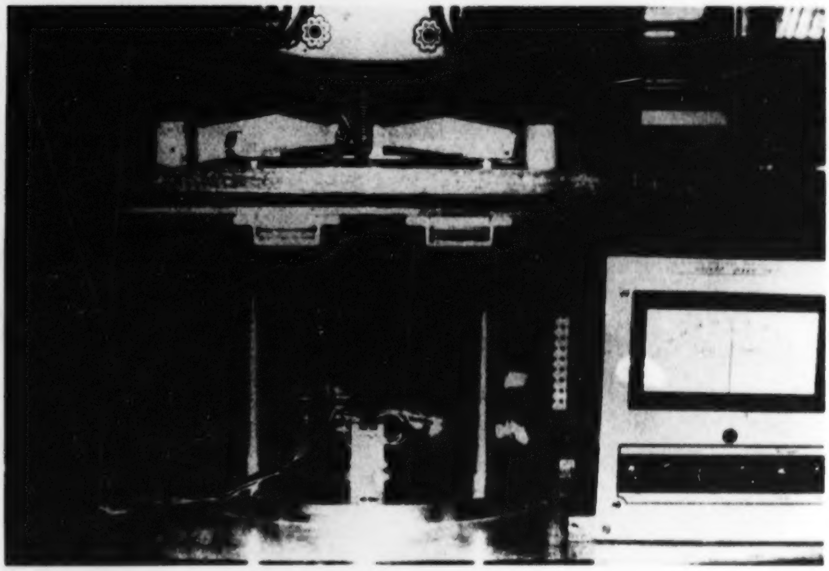

Figure 4: *Pan and kettle lifting force transducer*

2.1.4 Key twist and lateral pinch force (Fig. 5)

Twisting moment was measured by attempting to turn a simulated key either clockwise or anti-clockwise against a cylindrical transducer. The key could be fixed in 15 degree steps of pronation and supination. Two transducers were provided, of different sensitivities, for strong and weak patients.

Lateral pinch force was measured by pinching together two small platens which were connected to a transducer. These also rotated in 15 degree steps, and two different sensitivity devices were provided.

2.2 Electronic circuitry

The basic circuitry is shown in Figure 6. The conditioning unit (10 channel, RDP 2063) enabled a single strain gauge amplifier (RDP 2028 A) to be used to accept up to 10 bridges. The transducers for the "power" grip, the pan and the kettle devices were connected to this conditioning unit. The remaining devices were connected indirectly via a supplementary conditioning unit built in-house using analogue semi-conductor switches. The devices connected to this unit did not require the "warming current" provided by the main conditioner to the non-selected transducers. This current was necessary to minimise errors when transducers were sampled in rapid succession.

The amplified outputs from the selected transducers were converted to digital form for input to the computer via a D 109 digital interface card.

2.3 Microcomputer

An Apple II microcomputer was programmed to control the circuitry and to collect, display and store all the measurements required by the operator. The programme was developed to ensure that the equipment was user-friendly so that non-technical staff could operate the

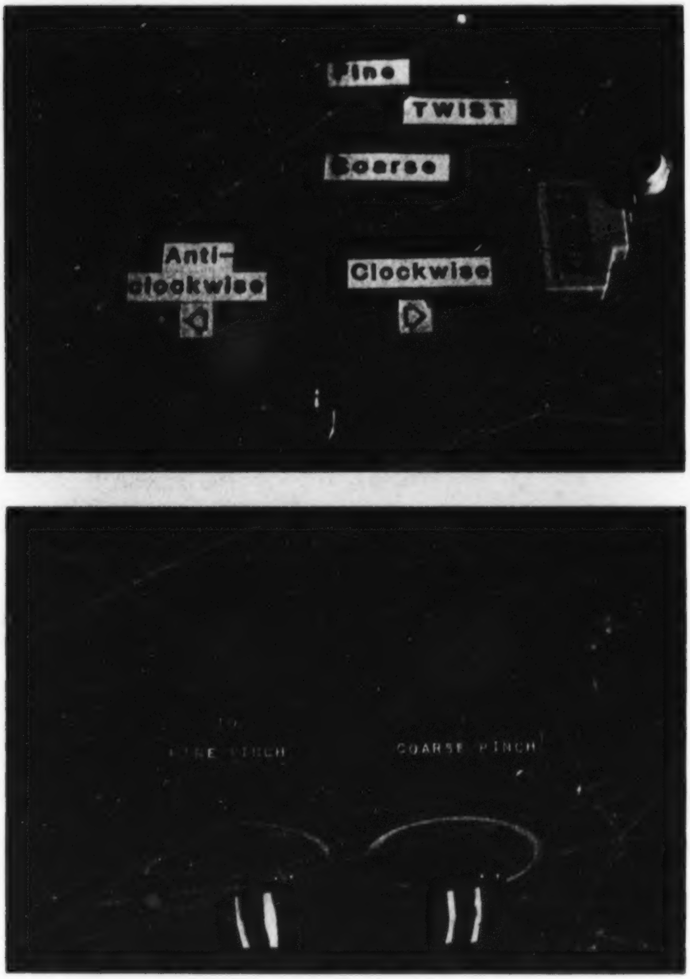

Figure 5 a/b: *Key twist (a) and lateral pinch (b) transducers*

system with minimal training. The operator did not need to alter any controls; all that was required was to respond to the 'prompts' issued by the computer. A flow chart of the basic program is given in Figure 7. Further details of the equipment and program can be found in Jones (1984), and Jones et al. (1985).

2.4 Calibration

The transducers were calibrated by the addition/subtraction of known forces. An Instron 3522 tensometer was used to apply these forces directly to the "power" grip, pan and kettle handle transducers. Dead weights, calibrated previously on the tensometer were used on the others. The twist devices had dead weights hung from a known moment arm.

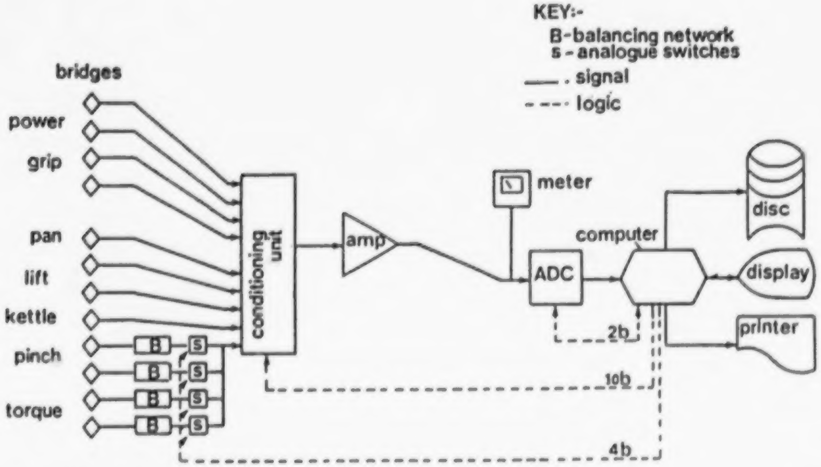

Figure 6: *Schematic diagram of circuitry.*

Accuracy and precision of the devices were assessed by applying known loads, and noting the discrepancy between these and the computer output. All the devices were accurate within + 4 per cent, − 0.7 per cent with a precision better than +− 4.4 per cent.

3.0 Subjects, patients and methods

20 healthy subjects and 38 patients were measured using the system. All the subjects and patients were given a brief introduction to the system. For "power" grip, the subjects were seated with their forearms resting on a chairarm. The elbow was maintained at 90 degrees of flexion, and the device was held vertically throughout the grip. A similar forearm position was adopted for the key twist and lateral pinch force measurements.

For the pan and kettle lift, the subjects stood in a comfortable position. The subjects also stood for the pulp pinch measurements. The key/lateral pinch unit was placed in a special adapter on its end for this test.

For each test, the subjects were asked for a maximum effort for as long as necessary to record useable data (a maximum of 8 seconds depending on subject reaction). They were not prompted during the task, nor told how they should tackle the task. The only prompt was an initial vocal one: "Please grip/lift/squeeze the device as hard/much as you can, and hold it until told to relax".

4.0 Results

4.1 Subject variability

To assess the inter-subject variation on each individual device, 7 to 11 healthy subjects were measured 8 consecutive times. The coefficient of variation, Cv ($= \sigma/\bar{x}$), for each subject was obtained as a measure of subject variability. The majority have a mean Cv less than 16 per cent, with the exception of the kettle lifting force with Cvs of 33 per cent and 36 per cent. These results confirm that subjects exhibit a large variation when tested on a single device, the overall range being 1.8 per cent to 63.5 per cent. Neglecting kettle lift measurements, this reduces to 33.1 per cent.

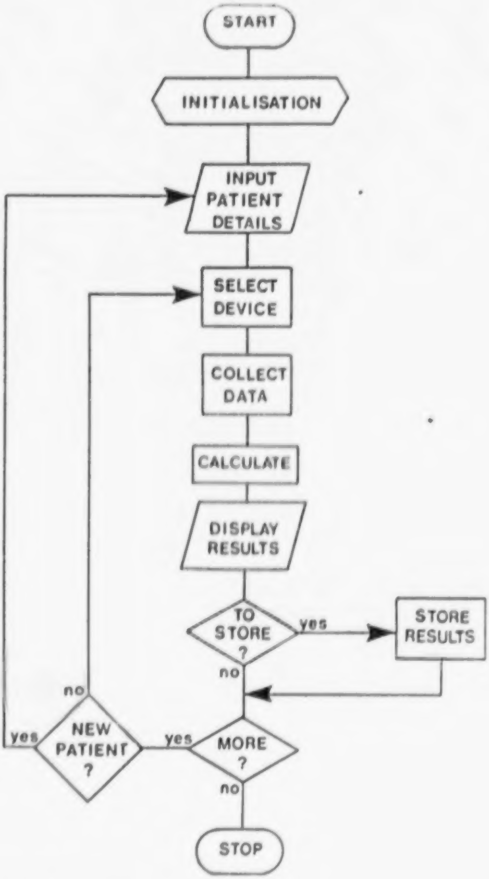
START
INITIALISATION
INPUT PATIENT DETAILS
SELECT DEVICE
COLLECT DATA
CALCULATE
DISPLAY RESULTS
TO STORE ?
yes
STORE RESULTS
no
MORE ?
yes
no
NEW PATIENT ?
yes
no
STOP

Figure 7: *Flowchart of data handling*

4.2 "Power" grip and finger force measurement

As expected, healthy subjects were much stronger than patients (a mean of c35ON against a mean of c11ON for patients). Unexpectedly, the middle and ring fingers were shown to be strongest. For both groups, almost two thirds of the "power" grip is provided by the middle and ring finger.

4.3 Pan handle grip force and lift measurement

For both groups, a large handle gripping force (greater than the lifting force) was required for lift to occur. Patients were much weaker than healthy subjects, and in some cases no lift was achieved. In healthy subjects, the grip at maximum lift was less than the maximum grip.

4.4 Kettle handle grip force and lift measurement

Here the gripping force is much lower than the lifting force for healthy subjects. For patients, the forces were similar for grip and lift. In both groups the maximum grip appeared larger than the grip at maximum lift.

It should be noted that, for patients, the minimum values obtained for lift and grip were both zero, i. e. no lift and/or no grip force on both devices.

4.5 Key twist and lateral pinch measurement

Results showed the weakness of patients compared with healthy subjects.

5.0 Discussion

5.1 Grip strength

This study, confirming the work by Ohtsuki, shows that in a "power" grip the middle and ring fingers provide the primary gripping force of around two thirds of the total "power" grip. The remainder is almost equally split between the index and little fingers. These appear to provide a supporting role to the middle and ring fingers and, possibly, a stabilising action on the object being held. Intuitively, the index and middle fingers are thought to provide the major contribution of a "power" grip because the thumb is in opposition to them. Studying pulp pinch results, we see this confirmed.

This study indicates that the relative performance of the fingers depends on the activity being undertaken.

The percentage contribution in patients reveals a similar distribution, though with greater variation. The middle and ring finger contributions are reduced, while the index and little finger contributions are increased.

5.2 Pan and kettle lifting

A relaxation in grip force occurs for a healthy subject before the maximum lift is achieved. This possibly represents an overcompensation in the grip required. As the lift proceeds, feedback stimuli determine that overcompensation has occurred and the grip relaxes to an equilibrium level. This is the minimum level at which a stable lift can be maintained.

Patients' force patterns are similar, but generally the grip does not show such extreme overcompensation, a flat grip force trace being more prominent. The absolute values are much less, on average only one third that of healthy subjects.

For kettle lifting no grip is necessary. Most healthy subjects hook their fingers and support the handle on the middle phalanges, i. e. a "hook" grip. Because the lift tends to open out the fingers, the grip at maximum lift is lower than the maximum grip. As the results show, a lift about three times that of a pan lift is obtained for about one third the handle grip force.

Patients also show a more efficient lift but at about one fifth that of healthy subjects with about half the grip. One of the observed limiting factors to kettle lift was a poor elbow movement. This was compensated for by patients "rocking" on to their heels, or trying to rise on their toes.

5.3 Key twist and lateral pinch

Both indicate the weakness of patients with arthritis, their results being about one third those of healthy patients.

6.0 Conclusions

A quantitative hand assessment system has been developed that has been shown to be accurate. reproducible. and easy to use.

Results of "power" grip and finger force measurement indicate the primary role of the middle and ring fingers. contributing 37 per cent and 29 per cent of the "power" grip respectively. and the subordinate role of the index and ring fingers. contributing 19 per cent and 16 per cent of the grip respectively. Pulp pinch results show the index finger to be strongest. followed closely by the middle finger and then. reducing rapidly. the ring and little fingers.

Patients with arthritis have much reduced "power" grip values though a similar distribution of finger contributions. the middle and ring finger taking a reduction to 33 per cent and 27 per cent respectively while the index and little fingers increase to 23 per cent. The pulp pinch results are again lower than in healthy subjects but with the same distribution. i. e. the index finger was strongest.

Therefore. in both groups. the task attempted appears to define the relative performance of the fingers. For the pan lift a large grip force is necessary to obtain a stable pan lift. Healthy subjects appear to overcompensate in the grip in the early part of the lift. with the grip relaxing as the lift progresses. Patients show limited overcompensation and have lower grip and lift forces. Kettle lifting does not require a strong grip. but for similar handle grip forces as for the pan handle the lift was much greater. Key twist and lateral pinch both showed the usual pattern of very strong healthy subjects and weak patients.

The great advantage of this system is its quantitative nature. which provides the ability to monitor individual patients accurately. The combination of measurement devices gives information on the hand condition not readily available by other methods. and patients' progress can be assessed even if the task is not completed. Patient fatigue is much reduced because each task is completed within a few seconds.

The accurate information produced using this system should enable us to acquire greater insight into the nature of patients' disability as well as allowing more objective appraisal of the results of treatment with. in consequence. more accurate treatment planning.

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Group 2:

Use of prostheses, orthoses, and technical aids

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Wheelchairs designed for activity and sport

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1. Introduction

Athletes of all disciplines show improved performance every year, which can be documented by comparing the results of Olympic Games from the beginning until the last games in Los Angeles in 1984. But not only well known sports show this effect due to enhanced physical condition of the athletes and ever better technical equipment, the sports for the handicapped are also affected by this development.

Comparable to the Olympic Games are the Stoke Mandeville Games for the handicapped organized every year in the United Kingdom. The results shown at these famous games point to improved performances of handicapped sportsmen and their equipment.

In the following, the development of the folding wheelchair and the sports wheelchair are demonstrated.

2. The history of the sports wheelchair

The first sports for handicapped wheelchair drivers came into existence after World War I. At that time, no special sports wheelchairs were available, and the disciplines were restricted to very static sports such as archery for instance. Most of the more dynamic sports disciplines could not be engaged in, which must have been frustrating for the handicapped athletes because their performance was not limited by the ability of the individual but by the technical equipment available at the time.

The first adaptations of wheelchairs to the individual purposes of the athletes were made by the sportsmen themselves. But soon manufacturers of wheelchairs developed special chairs, in cooperation with sportsmen and medical doctors. The standard folding wheelchair built by Everest and Jennings in the USA in 1933 was the main step towards achieving more mobility for handicapped people.

The differences of the earlier generation of sports chairs to the standard wheelchair lie in the smaller and lower armrest, the lower backrest, and a more backward situated center of gravity. The first chairs of this generation were built at the end of the Sixties. From that time on, additional adaptations of wheelchairs for athletics and sports appeared every year, and the development shows no sign of coming to a standstill.

Today, a sports chair has to meet the following requirements:

- It must be light for high mobility, maneuverability, and easy transportation
- The ball bearings of the wheels must be excellent

- For heavy duty use in sports only, it should be rigid to make it more stable
- The wheel camber must be negative to make the chair more maneuverable
- The center of gravity should be changeable for individual adjustment

One characteristic all sports chairs have in common is the high degree of mobility. This mobility and maneuverability result from the lower weight compared to the standard chair, the material of wheels and ball bearings, the tyres, and the fact that most of the sports chairs have wheels with negative wheel camber. Armrests are not always used and can be removed by the user. The center of gravity can be individually chosen more forward or backward, depending on the physique and ability of the driver. For heavy duty use, the sports chairs are not foldable, but the wheels must be easy to dismantle. A special wheel bushing plate permits up to 15 different positions for the drive wheels. Considering all modifications of the sports chair, it differs greatly from the standard chair, and not only in appearance.

The development of the sports chairs, in the meantime, has gone so far that different chairs for different disciplines are available today. We distinguish between allround chairs (they are still foldable), basketball chairs, tennis chairs, racers for long and short distances, and other special adaptations.

3. Advantages of a sports wheelchair

First of all, the sports chairs do not look as if they had been designed for handicapped people, as standard wheelchairs often do. For many younger people who are still physically active, the sports chair is a real alternative.

Rehabilitation centers, which have great experience in the treatment of handicapped persons, have recognized that sports are a good therapy for helping to reintegrate handicapped individuals. Therefore wheelchair sports have become part of rehabilitative management, being viewed also as longterm therapy since sports strengthen muscles, stimulate blood circulation and are a good prophylaxis against scoliosis.

At the same time sports help handicapped individuals to feel more self-confident and independent. They provide opportunities to get out of a sometimes isolated situation and, for instance in the case of wheelchair tennis and table tennis, give an opportunity to compete with ablebodied people.

For manufacturers and users, there is another positive side effect: producing sports wheelchairs provides manufacturers with a lot of new information about the physiques of disabled people, resulting from the close cooperation with handicapped individuals, physicians and therapists. This additional information not only influences the production of sports wheelchairs but also gives new directions to the development of standard wheelchairs. Therefore, the new generation of standard wheelchairs is something of a compromise between sports chairs and standard wheelchairs.

The Ortopedia Allstar and the Everest and Jennings Ultralight Premier can be used daily, for working, for indoor and outdoor use, they are foldable, have many advantages of pure sports wheelchairs, like negative wheel camber, adjustable center of gravity, and they have an appealing look.

4. Disadvantages of sports wheelchairs

Naturally, not only active handicapped people are attracted by the new design of sports wheelchairs. There is a trend especially among younger handicapped persons, to own such a sports wheelchair. But a sports wheelchair is not always the best piece of equipment for a handicapped person. The diminished support of the body because of the low backrest, and the lack of strong armrests presuppose a low location of paraplegia and intact muscles of the upper part of the body. In case of high paraplegia, insufficient support of the body can cause severe accidents as a result of having no control to keep the body in the chair. Therefore, manufacturers, sellers and users must know that despite the better appearance of a sports wheelchair, it is only suitable for certain disabled people. The physicians must be well aware of their responsibility in prescribing not only "a wheelchair", but the right one.

5. Conclusions

During the last years sports wheelchairs have been developed to meet the demand especially among younger handicapped people for a non-conventional wheelchair providing more mobility and allowing sport activities.

The yearly Stoke Mandeville Games for the handicapped in Great Britain with their international participants demonstrate the sports abilities of the handicapped. The success of the development of special sports chairs is in improving performances. Another fact is the therapeutic effect of sports to help the handicapped find new self-confidence and get out of isolation.

New modular wheelchair models

L. W. J. B. van Huijgevoort, Hoensbroek (The Netherlands)

1. Introduction

At the Hoensbroek Institute for Rehabilitation Research a project was initiated to study various needs for wheelchairs and technical possibilities for new wheelchair models. The diversity of wheelchair needs was already demonstrated by a previous study of the Dutch organization (Gemeenschappelijk Medische Dienst) that advises on technical aids.

It was concluded that wheelchair models combine properties in the following areas: environment, way of propelling, type of seat, way of transportation.

For example, a most common wheelchair can be characterized as a wheelchair for indoor use, with hoops for propelling and a one position seat, which is foldable to a package approx. 30 cm wide and one by one meter. In a similar way several other possible combinations of wheelchair models exist.

A classification of wheelchairs based on these characteristics can be helpful for people who have to decide which wheelchair should be chosen for an individual, but it also gives a first overview of design concepts for wheelchair development.

The list of wheelchair models was a starting point for the modular wheelchair project aimed at designing a set of modules which could be used as major parts for necessary and desirable wheelchairs.

2. Specific problem formulation

First, it was recognized that there is a need for several different kinds of wheelchairs for different individuals, as demonstrated by the various types available on the market. Secondly, it is assumed that many wheelchair users require more than one type of wheelchair due to different activities or different environments for or in which the wheelchair has to be used. Thirdly, there is the problem that wheelchairs have to fit body dimensions of individuals, which requires a possibility to choose from a range of dimensions or to adjust wheelchair parts.

This was the reason to study the possibility of designing wheelchair parts as modules. The design was to focus especially on the possibility to change an indoor wheelchair for outdoor use, and to accommodate individual requirements, e. g. body dimensions.

It was recognized in an early stage that the great diversity of wheelchair types poses a special problem, and a single design solution solving so many problems cannot be found.

In the project a limited choice was therefore made of certain special types of wheelchair parts that could be fitted together.

The following wheelchair types were chosen for indoor use design:

- a push wheelchair with an extra motor help,
- a self-propelled wheelchair with the centre of gravity above the large wheels, with a possibility to place the large wheels further back;

and for outdoor use:

- a hand-crank wheel propelled extra wheel with brake and three speed ratios,
- an electrically driven extra wheel with motor and battery, placed on the front wheel.

These wheelchair parts were also built as prototypes in order to test their functionality.

The push wheelchair and self-propelled wheelchair were combined in one wheelchair frame, with a possibility to change wheel positions and wheel diameters.

The seating part of the wheelchair consisted of an existing office chair with adjustable seating angle.

The above wheelchair parts were designed, built and tested as prototypes. Requirements with respect to the wheelchair dimensions (especially seating part) were also studied.

3. Some results of prototype tests

First, the wheelchair subframe for indoor use was built and tested. The centre of gravity effect of this "mid-wheelchair" has advantages such as rolling resistance and low turning resistance of the castor wheels. The chair has better maneuverability on the spot. Another advantage is the low responsiveness to side slopes: there is no sideway force in this case.

A disadvantage was the poor ramp climbing performance, which is especially felt by older wheelchair users with lower arm strength. Further development therefore is directed at increasing the ramp climbing performance of the "mid-wheeler".

Some other features were built into this indoor wheelchair, such as an adjustable seat angle that makes it possible to sit forward, upright and backwards with a range of about 10 degrees.

Stabilization wheels at the rear are castor wheels, too. These wheels being spring mounted, it is also possible to lean backwards over a large angle. Seating angle adjustment was appreciated very much by the test persons, but the lock/unlock mechanism together with the body rotation is still difficult to operate.

Secondly, a hand crank wheeled "third wheel" was built and tested. This wheelchair part enables the indoor wheelchair to be operated outdoors. A more ergonomic way of propulsion is built into this "third wheel", together with a brake, selectable gear ratio and direct steering.

With this third wheel, the wheel base is increased considerably. In our model of the indoor wheelchair, it is possible to lift the front castor wheels of the wheelchair, so that only the front wheel and the hoop wheels touch the ground. A possibility is built in to use the springs of the rear castor wheels to suspend the hoop wheels for outdoor use.

The third wheel can be attached to the indoor wheelchair without much force, but it still needs some manipulation.

One of the disadvantages of this wheelchair with a third wheel is the high speed that can be obtained. The combination seems to ride safely on a straight road but is rather unstable in road curves. There is no stabilizing mechanism that prevents side-way tip-over, like in a bicycle. So the gain in increased speed must be limited in order to prevent it from tipping over.

Other parts that were built and tested were a push motor-help and an electrically driven "third wheel". The push motor-help is functioning rather well, and this unit can be simple and therefore cheap, which means a good ratio between performance and costs. The electrically driven "third wheel" was less successful, mainly because of its weight (large batteries!). Maneuverability, which is necessary for parking or stalling, is very poor because of large self-resistance in the motor and transmission, great length, and the heavy steering force needed. Due to the fact that the mass on the front wheel is large, curb climbing ability is poor, too. Thus we have to conclude that an electrical third wheel has to be much simpler, lighter, and easier to maneuver.

Potential demand for such a device, however, is still expected to be large, because many wheelchair users prefer, and are able, to use a handpropelled wheelchair indoors, and will use an electrically driven wheelchair outdoors. There are already some electrically driven "third wheels" on the market or under development.

4. Conclusions

In this project we started by investigating the market, especially the market demand of users, and the offer of wheelchair manufacturers. The great diversity found made it logical to decide that many possible variations and options should be possible by modules. In fact, there exists a kind of "jigsaw puzzle" with respect to a variety of functional and technical requirements.

The design process for construction of such a wheelchair is a process with numerous input variables, and it is rather difficult to achieve a synthesis, a concept that would meet all requirements. This may possibly be the reason for some of the problems revealed during testing of our model. Further development is planned to correct the main disadvantages.

The analyses of wheelchair products, wheelchair demands, and the wheelchair market in general carried out in this project give a good base for future work in the Institute for Rehabilitation Research.

Audit of a regional wheelchair service

J. Hunter, Edinburgh (United Kingdom)

– Abbreviated version –

1. Introduction

In Great Britain, a non-powered wheelchair may be provided and maintained free of charge by regional centres to any disabled person at the request of his doctor. The centre in

Edinburgh serves South East Scotland (population 1.2 m). The number of patients has increased from 4000 in 1977 to over 8000 in 1985 (6 wheelchairs per 1000 population) while staff have been reduced slightly.

This study describes the characteristics of wheelchair users, the patterns of wheelchair prescriptions and attempts to evaluate the service to patients.

2. Patients

The majority of wheelchair users are elderly (Table 1). An increasing proportion of new referrals are over 75 (66 % are female, 34 % male); there is also a high death rate (50 % in 3 years).

Table 1: *Age structure of wheelchair population* (Edinburgh, 1984)

Age	All patients (%)	New referrals (%)
< 15	4	4
16–34	12	3
35–54	18	10
55–64	15	16
65–74	24	26
> 75	27	41

The disease pattern (Table 2) reflects that of the severely disabled population found in the Harris (1971) survey. The commonest diagnosis is stroke (25 %); only 6 % are paraplegic or tetraplegic.

Table 2: *Principal diagnostic categories of wheelchair users* (Edinburgh, 1984)

	All patients (%)	New referrals (%)
Neurological	51	46
Musculoskeletal	20	21
Amputation	9	8
Cardiorespiratory	6	10
Congenital	4	1
Others	6	10
Not stated	3	4

Only 10 % of users are wheelchair independent, a further 15 % are dependent on the wheelchair for mobility indoors. Thus, 75 % are ambulant, usually with aids, in their homes. 85 % regularly use their wheelchairs outdoors, almost always propelled by an attendant. In 34 % of homes, steps prevent effective wheelchair use. This architectural barrier may be overcome more easily with a self-propelled than purely attendant-propelled chair. Most wheelchair users require other aids to daily living, mainly bathing or toileting, and 64 % have one or more allowances for disability.

3. Wheelchairs

A very wide (but nevertheless limited) range of wheelchairs can be prescribed. Most are lightweight chairs made to government (DHSS) specifications, but a number of commercially available chairs and non-standard chairs can be provided when required clinically. 4 % of patients have powered indoor wheelchairs, but self-controlled powered outdoor chairs cannot be provided.

There is a trend towards attendant propelled chairs mainly due to the demographic changes.

4. Service to patients

Chairs are loaned to patients. When no longer required, they are refurbished and re-issued. Turnover is therefore high. Demand increases by 6–7 % each year and is seasonal. The summer peak is an indication of the social value, while the winter trough reflects medical need. Thus, there is always a potential supply problem, buffered only by a relatively large (10 %) store of wheelchairs.

5. Delays in supply

Ten years ago, all patients were assessed individually for a chair, but this produced inevitable delays, particularly in the community where a clinical assistant visited the patient in his home. In hospitals, therapists did most assessments, and delays were much less. Since 80 % of chairs provided were standard ones, usually with a cushion, we started issuing chairs on the basis of limited knowledge of the patient. A 98 % acceptability rate was achieved, and the simplified procedure was introduced generally. There has been a significant reduction in delays, mainly due to use of the form by hospitals and direct GP referral, but the delays in domiciliary assessment have also been reduced substantially.

6. Patients' views

A postal survey in 1977 showed that 18 % had a problem, usually a repair or replacement, and 4 % were dissatisfied with the service. An occupational therapist visiting independently in 1979 found a 13 % problem rate. A further postal survey in 1984 and visits by a doctor found that 16 % had problems, usually minor, and only 2 % complained about the service. There is a general dissatisfaction with DHSS chairs, mainly on cosmetic grounds. The most severely disabled 1 % of users have problems, usually of posture, which are difficult to solve.

7. Costs

Bulk purchase of chairs ensures lowest possible prices (£ 100 for simplest chair, average £ 130–£ 150). The estimated half life of chairs is 9 years. The average cost of funding the service (excluding purchase of chairs) was £ 40 per chair in 1984.

8. Conclusions

The wheelchair service is evolving to cope with changing patient needs, particularly the elderly. It is efficient and generally effective, although there are unsolved problems with the needs of the most severely disabled. Failure to provide powered outdoor chairs is a serious deficiency, but this is a political decision.

Early assessment of communicative abilities by means of caregiver/child-interaction analysis

L. J. M. van Balkom, Hoensbroek (The Netherlands)

1. Introduction

The roots of early speech, as Vygotsky pointed out many years ago (translated in 1962), are social. Early social interactions provide the vehicle through which the child acquires the linguistic structures, much of the semantic content, and the social uses of language (McLean & Snyder-McLean, 1978). There has long existed a general awareness of the close relationship between social interaction and functional language use. Piaget (1926 (1959)) and De Laguna (1927) were among the first to describe the view that the main function of language is the communication of thoughts or ideas to each other.

Their work was overshadowed by structuralism in linguistics and behaviourism in psychology. Thus, linguists were mostly interested in structural (grammatical) descriptions of language patterns, and psychologists tried to describe language development as a passive, imitative process initiated and formed by adult language input. In the early sixties an important theoretical conflict dominated renewed attempts at the functional explanation of language development. On the one hand, the child was seen as genetically predestinated to acquire language. According to this view, children learn to talk because they were biologically prepared for it (Lenneberg, 1967) or linguistically pre-programmed to do so (Chomsky, 1965; McNeill, 1966). On the other hand, psychologists accentuated the influence of the social environment in shaping and stimulating the child's language learning (Skinner, 1957; Braine 1963).

The debate between those who hold language acquisition as an innate and maturation process, and those who argue that language development is a primarily learned and shaped process by environmental influences culminated in Chomsky's critique, in 1959, of Skinner's "Verbal Behavior" (1957). Since that time a great deal of psychological and linguistic research tried to describe arguments in favour of, or in opposition to, one of the views. This historical argument led to studies predominantly focussing on describing linguistic structures in child language (Bloom, 1973; Brown, 1973; Slobin, 1973) or adult language input patterns (Snow, 1972; Snow & Ferguson, 1977). Both the nativist and environmental view saw child language development as an essentially passive process with respect to forces of destiny and circumstance (Bloom & Lahey, 1978).

Now, it has become clear that neither view is satisfying in describing and explaining child language development. The child, in fact, plays an active role in gathering and processing new information. Child language development has to be studied in an information exchanging context between child and caregiver (Conti-Ramsden, 1983, 1984). Thus, recent approaches to the study of child language have emerged from a renewed interest in the functional aspects of language use, in contrast to the past decades.

The study of the development of communicative abilities in handicapped children has not yet received substantial attention, despite the recognition by practitioners of its necessity and usefulness for clinical application (Roth & Spekman, 1984). Most clinicians do not yet have an adequate framework for assessing communication problems (regardless of their foundation). Interaction analysis as an assessment tool is especially important for early recognition of language and communication problems (Grohnfeldt, 1983; Schiefelbusch, 1984). It is not necessary to await clearer delineation of normal developmental sequences in language development in order to construct a method for assessing communicative abilities. It is possible to draw on theoretical and empirical literature in constructing a framework for assessing communicative abilities (for example: Rieke et al., 1977; Clezy, 1979; Schachter, 1979; Russo & Owens, 1982; Barnes et al., 1983; Wells, 1984, 1985; Van Ierland, 1984).

2. Interaction, a prerequisite for communication and language development

Being a human being essentially means being human together with others. The most striking example is the dependence of a new born child on his caregiver; without this, the child would not have a real chance to exist. The child's dependency does not mean passivity; on the contrary, the child is very active, developing from 'reflexive' sucking to self-controlled use of it. Being a human being also means 'co-operative acting', or 'interacting'. The early mother/ child interaction soon gets structure; a ritual pattern in turn-taking develops for several daily activities, for example feeding, dressing, going to sleep, reading or telling stories, going for a walk. All of these daily activities occur according to a set pattern of beginning, executing and finishing.

Another essential aspect of interaction is 'signing'; we sign to each other positive and negative feelings about how we think things are, or are not, to occur. This signing matures to 'communication'. For example, when we lift up a little child, the following patterned activites are evident:

- The caregiver looks at the child while kneeling down.
- Soon after that, he will stretch his arms out towards the little child (while maintaining eye contact with the child).

Here, the little child plays an active, independent role. First, there is eye contact with the adult, then the child has to guess the intention of the observed action. After that, all the child's first turn-taking has to do with confirming the intended action by looking and walking to the adult. The child raises his arms, so the adult can take and lift him up. Of course, the child can also refuse co-operating in the lifting-up action by disrupting eye contact, turning his body and walking away. This example of 'signing' illustrates that the child knows the patterned behaviour associated with 'lifting up', in anticipating the expected patterns by taking the first turn in order to sign 'Yes, I want' or 'No, I do not want'. This sort of signing will develop to communication.

Is communication more than interaction? Communication, in fact, is the exchange of meaning within a social interaction. So in the above 'lifting-up' example, the initiative to lift up the child can be honored or refused. In case of refusing, the initiative, you may say the interaction of 'lifting up the child' has not happened, but the communicative intention of 'lifting up' has been understood successfully (the exchange of meaning is adequately interpreted by the child). The life of a child age 1 is filled with this sort of meaning exchanges and signs. The element of exchange of meaning in social interaction is known as communication.

These signs, which the child derives from observed patterns of behaviour, form the introduction for the use of the first single-word utterance at age 1 (Tervoort, 1984; Key, 1980). Long before speech is used, the child structures and interprets his surroundings (world) as meaningful. So, early social interaction facilitates advances in communication and specific language abilities of children. The language learning strategies of children and language teaching strategies of parents change developmentally (Lasky & Klopp, 1982). The child gradually learns to influence the environment and to persuade persons in this surroundings; step by step, he learns the benefits and rules of communication (Lloyd & Beveridge, 1981).

Each social environment uses its own communication rules, which the child has to acquire. In cases where the child satisfies these rules for communication, he may expect a reasonable reaction to his actions and spoken utterances. Hence, interaction and communication is of importance to cognition, language acquisition, as well as socio-emotional development (McLean & Snyder-McLean, 1977; Schachter, 1979). The exchange and interpretation of meaning is dependent on the social context in which it takes place.

A method for early assessment of communicative abilities therefore has to consider morphosyntactic, semantic as well as pragmatic aspects (Rieke, 1977; McLean & Snyder-McLean, 1977; Bloom & Lahey, 1978; Wells, 1981; Van Ierland, 1984; Wells, 1985).

3. Clinical tools for assessing language behaviour

Traditional clinical assessment methods classify the speech and language impaired child according to medical etiology, which presupposes that treatment will change according to the etiology (Kleffner, 1973; Clezy, 1979; Bloom & Lahey, 1978). This traditional approach is predominantly child-centred and formally assesses distinctive language levels (as syntax, semantics, vocabulary, and morphology). Most of these traditional methods use language tests and/or clinical observations of child language behaviour. In using this child-centred techniques they try to define disorders and retardation in language development. On the basis of test scores for demonstrated language behaviour, the child will be labeled as language-disordered, and predictions are made about the way in which language development will continue.

Predictions made on the basis of clinical test procedures however have severe shortcomings:

- Tests mostly give a rigid sequencing in language development stages; in fact, there is an intra- and inter-individual variation in language and cognitive development. One also has to consider sociolect influences on the language a child acquires (Van Ierland, 1982).
- Test scores are interpreted as direct evidence for specific problems in language behaviour (for example pure morphosyntactic problems). In fact, there is always a mutual relation between syntactic, lexical-semantic and pragmatic language performance (Bloom & Lahey, 1978).
- Test scores cannot give an impression of actual communicative competence and abilities (Clezy, 1977; Wells, 1985).

These shortcomings in traditional language assessment tools necessitate another approach, in which the interdependance of language functions can be assessed. In the above mentioned test procedures the essential role of the interaction between the child and his caregiver is neglected. Child and environment variables are not interpreted as mutually related and dependent. For that reason, an analysis of the child/caregiver interaction is an alternative for traditional test diagnostics.

4. Basic ideas for interaction analysis

In constructing a method for 'interaction analysis of communicative abilities' some available 'assessment' methods contributed in the construction of a paradigm of such an analysis. According to the linguistic distinctions in language form, content and use (Bloom & Lahey, 1978), the framework for interaction analysis considers mutual relationships between morpho-syntactic, semantic and pragmatic categories. The relationship between these categories is expressed in contextual terms, i. e. turn-exchanges, direction and relation of actual utterances to proceeding and following utterances, characteristics of initiatives, reactions and comments, topic shifts and topic changes. The main resources for constructing a method for interaction analysis are

- mother-child discourse (analysis), i. e. speech act theory;
- baby-talk (adult language-input characteristics);
- spontaneous speech analysis (i. e. LARSP);
- communication assessment and remediation programmes.

5. Interaction Analysis of Communicative Abilities (IACA)

Important criteria for constructing a method for analysis of caregiver/child interaction are:

- *Practical application* as a clinical tool especially used by speech therapists for the assessment of communicative abilities of language-development disordered children;

- *The selection of relevant linguistic variables* out of an extensive list of possible analysis categories known from research reports;
- *The reliability and validity* of selected linguistic variables for interaction analysis.

These three criteria form the methodologic guideline for designing a research project aimed at the construction of an interaction analysis meant for early assessment of communicative abilities of language-development disordered children. An extensive list of variables for child and caregiver talk is selected out of relevant psycholinguistic literature. The variables are organised in lists for: morphosyntactic, semantic, and pragmatic analysis.

The ultimate goal of the research project is to construct a clinically applicable, objective, and reliable method for assessment of communicative abilities of child and caregiver out of the extensive list of variables (cf. Russo & Owens, 1982).

6. Longitudinal study

In order to fullfill the requirements for constructing such a method for analysis of the caregiver/child interaction, the following methodological issues are used:

- Longitudinal study of 12 high-risk infants with primary language development problems. The children, aged 2–2½ at the beginning of the study, are followed longitudinally until they are 3½–4 years old. Nine observations are planned with two-month intervals. Each observation will last for 30 minutes of 'free play'.
- Longitudinal study of 6 normally developing children, starting at age 2–2½ until age 3½–4. Nine observations of 30 minutes of 'free play' are planned with two-month intervals.
- The observations are videotaped. A random selection of 10 minutes out of the observed 30 minutes will be divided into twenty 30-second segments.
  At the end of the research project, each child gets a 90 minutes sample gathered over a period of 18 months.
- The 10-minutes samples are transcribed in traditional orthography for vocal and nonvocal utterances of child and caregiver. The fully transcribed utterances will be analysed on morphosyntactic, semantic and pragmatic aspects by means of an extensive list of variables. These analyses are performed by a panel of three independent judges, with knowledge of linguistic analysis and speech therapy. Each analysis category is described and defined in a manual for coding child/caregiver interaction.
- The 10-minutes samples additionally will be coded for each 30-second segment on thirteen 5-point rating scales by three independent speech therapy students. The rating scales are extrapolated out of the extensive variables list for IACA, so that they are directly linked to the linguistic analysis. So, judgements made for each segment by means of ratings and linguistic analysis can be compared for statistical reasons (cf. Russo & Owens, 1982).
  The students only get descriptions of the thirteen rating scales illustrated with some examples. The rating scales will be used three times for each child (after the first, sixth and ninth observation). The observers only use videotaped material, they have no additional information from the transcriptions. In using different observers for the segmented videotaped or transcribed observations, it is possible to get information about reliability and validity/interval consistency of the variables used for interaction analysis.
- In following the children longitudinally, information is obtained relative to which variables indicate developmental growth for each child. For this reason, especially the longitudinal study of the normally developing children is important.

- The observation of each child is analysed as soon as possible after each session. As result of each analysis, a speech therapist gives relevant information to clinicians and parents about remediation planning. During the two-month intervals between analyses of subsequent observations of a child, intervention is evaluated in order to get information about which variables are used for clinical remediation planning.

7. Additional information

The speech therapist visits parents of language-disordered children each time after finishing the interaction analysis of a preceding observation session.

During the first, the sixth and the ninth (last) home visit, the speech therapist uses a questionnaire concerning issues about: early communicative abilities, senso-motoric abilities, socio-economic status, evaluation of analysis and/or remediation plan. Parents receive a documention map containing information about the research project. The research project started only recently so that this paper only reports issues of "work in progress". This project gets scientific support from the Institute of General Linguistics, University of Amsterdam. In co-operation with local pediatric institutes and the Speech and Hearing Centre "Hoensbroek", children will be selected for this research. The normally developing children will come from local kindergarten.

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Pressure splints – an aid to rehabilitation

G. Rasmussen, Klampenborg (Denmark)

Aim. This study was carried out in order to examine the purpose of applying URIAS splints in combination with intermittant pressure in the management of stroke patients and other categories of patients.

Methods and Material. Included in this study were 30 patients with various vascular disease. The orally inflated pressure splints, URIAS, and a prototype of a pump with some of the functions of FLOWPULSE were used. The pressure never exceeded 40 mm Hg, but the intervals in applying intermittant pressure varied.

Results. Intermittant pressure of 40 to 30 mm Hg, with an interval of 3 sec's alteration in the pressure, proved to be most effective. In addition to reduced oedema, the patients described relief in pain, spasticity, contractures, stiff joints, cold feet and hands, and ulcers diminished. Many patients continued using the splints at home.

Conclusions. As Margaret Johnstone has stated and proved for the treatment of stroke patients, this study also supports the concept that the splints are a valuable physiotherapy aid regarding the following purposes: to inhibit spasticity; to control associated reactions; to assist movement in recovery patterns; to make early weightbearing possible; to treat sensory loss. Applying intermittant pressure even makes the treatment as such more effective, especially on symptoms as oedema and pain.

State of the art of implanted multichannel devices to mobilize paraplegics

H. Thoma, M. Frey, J. Holle, H. Kern, W. Mayr, G. Schwanda, and H. Stöhr, Vienna
(Austria)

1. Introduction

Functional electrical stimulation (FES) to mobilize paraplegic patients is achieved by surface electrodes (Kralj, 1981; Jaeger, 1983; Petrovsky, 1983), intramuscular electrodes (Marsolais, 1984), or by stimulation of the peripheral nerves (Brindley, 1978; Thoma, 1975). Comparing problems of transfer of research results to application in practice with those of other medical disciplines (e. g. surgery), the rehabilitation transfer seems to be more difficult. This fact became obvious when we started our first implantation of the so-called "leg pacemaker" in humans in 1982. (Regrettably, this event got publicity in the media including the press, but that happens in all medical fields. Media reports of Barney Clark's first total artificial heart implantation in Utah resulted in worldwide recognition of the group and a 3 million dollar support for further improvement of the bloodpump.)

Our progress in our first step – implanting 16-channel devices for extension of knee and hip joint – may not have been enough to make a big impression on disabled people. But at least experts in rehabilitation would know that any research and application has to be done step by step. Barney Clark's heart implantation encountered numerous problems and even technical failures. But there is no other way to get clinical experience.

Stimulating and inhibiting factors for a positive transfer of research results to application in practice in the rehabilitation field are:

Stimulating factors:

(1) Interest of and benefits for disabled individuals
(2) Interest of industry
(3) Social and economic necessity
(4) Clinical indications

Inhibiting factors:

(1) Indispensable patient cooperation
(2) Health policy restrictions
(3) High financial investment
(4) Long duration of innovative research programs
(5) Incompatibility with present rehabilitation strategies

Today, human application of the "leg pacemaker" faces more inhibiting than stimulating factors. This was the basis of our decision to stop the present program and to develop the next step: implantation of 40-channel units to stimulate extension and flexion of knee and hip joints to allow paraplegics to climb steps. This new implant is scheduled to be available in early 1987. To get patient acceptance, we have to offer patients real and permanent benefit. We have therefore defined basic requirements of standing and walking with FES:

- Stability and function of device (3–5 years)
- Special criteria for the design (e. g. implantation, automatic control and check systems, miniaturization)
- Immediate access to the device during the entire day (night) without any delay

- Better function and increase of quality of life compared with present methods (wheelchair)

The following problems have been evaluated, and partly solved, since 1982 when we implanted the first FES device in a human (2 x 8 = 16 channels, for stretching of knee and hip joints):

- Fiber selective stimulation of the muscle via the corresponding peripheral nerve
- Method of patient screening and preoperative training
- Postoperative force and balance training

2. Material and methods

In 1971, a fatigue-free stimulation method of the neuromuscular system was developed in our department, called a "round about electrode" (Thoma, 1975). This method is based on:

(1) Fibre selective stimulation by means of electrodes that are positioned directly on the epineurium of the nerve (inhomogenous electric field across the nerve square)

(2) Submaximal stimulation current (stimulation of less than 80 % of the fibres)

(3) Periodical switching (plus/minus/zero) of the stimulation current among 4 electrodes placed around the nerve (up to 36 combinations)

Using submaximal stimulation allows a recovery of the non-activated fibre groups due to multiple electrodes. On average, all fibre groups and all electrodes are loaded equally.

The development of stainless steel electrodes for long term application was tested (for one year) in animal experiments. Different electrical impulse patterns to achieve smooth, strong and constant muscle contraction were investigated. In other experiments, the electrochemical and mechanical influence of the electrodes and long-term electrical stimulation to the nerve and muscles were investigated. The changes of the nerve due to mechanical or electrochemical influence of the stimulation was found to be within reasonable limits (Frey et al., 1983).

As a result of these experimental investigations, stainless steel electrodes were developed, consisting of 12 monofil wires with a diameter of 0.05 mm twisted in a spiral design and covered with silicone rubber. A battery-driven, portable 16-channel extracorporal control device (size: 170 x 180 x 30 mm) was constructed and connected with a commercially available cardiac pacemaker called "Transcutor", which consisted of a receiver coil, electronic management of the impulses and connection leads to the electrodes. All parameters for optimal functional stimulation of peripheral nerves, such as impulse duration, frequency, current amplitude, and pattern of the pulse series, can be preprogrammed in the external control device. Two crutches are equipped with two switches each, to give the patient the possibility of controlling his gait (swing-through or four-point gait) with two fingers of the left or right hand respectively.

The first clinical application of this system for functional electrostimulation aimed at mobilizing paraplegic patients was performed in October 1982. A complete spinal cord lesion was located between Th-9 and Th-12 in two female patients, 41 and 22 years old, caused by traffic accidents, 21 years ago in the first and 4 years ago in the second case. In both patients, the femoral nerves and infragluteal nerves were connected with 4 electrodes each to stimulate the quadriceps femoris muscle for knee joint extension, and the gluteus maximus muscle for hip extension.

Operating procedure: A transverse incision was made in the gluteal region just above the foramen infrapiriformis. The infragluteal nerves were located, and 4 electrodes were attached to the epineurium of the nerve branches with 8/0 prolene. The electrodes were connected subcutaneously with the implant placed in the lower abdominal wall, 5 cm medially of the iliac spine. Through another vertical incision in the groin region, the femoral nerve was isolated and again connected with 4 electrodes in the same way. The attachment of the 4 electrodes on each nerve was done in a square position to achieve the method of "round about electrode".

3. Results

The postoperative period in both patients was uneventful, and electrostimulation with increasing duration was started on the 10th day post-op. The patients were told to stimulate their muscles 3 times a day for about 20 minutes, and periodical follow-up studies were performed in our clinic. During the first 3 postoperative months, the adjustment of stimulation current of the 3 different combinations relative to muscle force was unstable, but after this time the stimulation current remained stable in both patients. During the postoperative training the muscle force increased between 300 and 400 %.

Five months after the operation, both patients were sent to the rehabilitation center in Bad Häring, Tyrol, to learn, and train, how to use their implanted stimulation system for standing up and walking with the aid of crutches. One year after the operation, both patients were able to stand up from their wheelchair and walk about 100 metres with the aid of crutches (Fig. 1–3).

Encouraged by the experience of these patients, two more patients received our implants in November 1983. 4 weeks postoperatively we started the training, which was similar to that of the first patients.

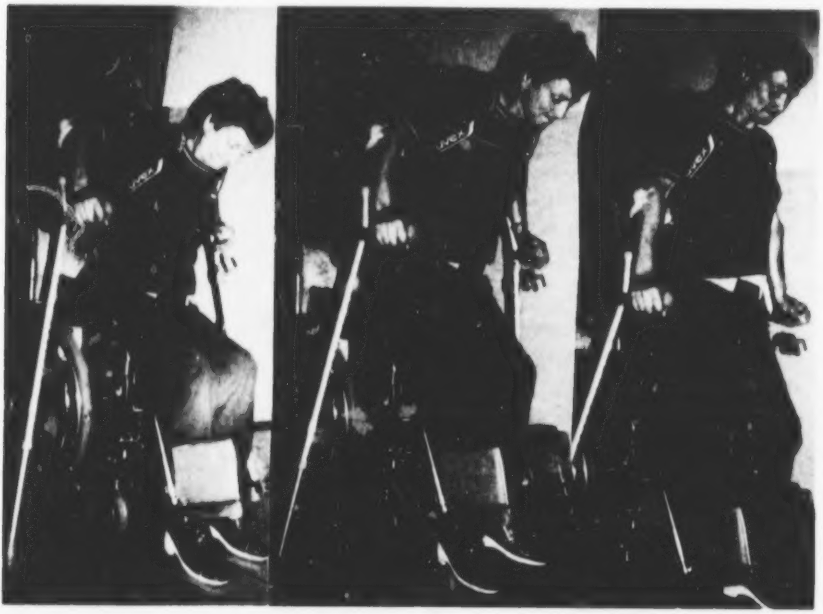

Figure 1: Standing up

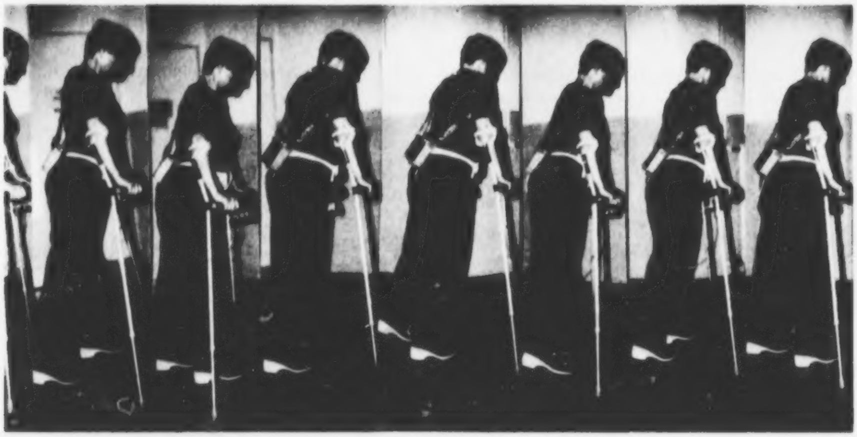

Figure 2: Four point gait

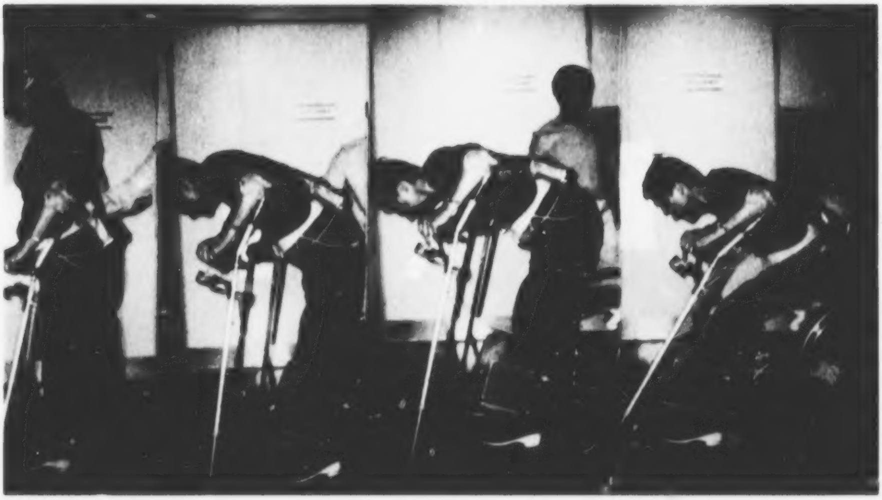

Figure 3: Sitting down

4. Discussion

Since our clinical results demonstrated no definite technical or biological limitations for the application of the described stimulation system, we are encouraged to proceed with our research program. But there are still important problems to be solved:

- Long term stability and miniaturization of all implanted parts
- Standardization of the position of the electrodes, leads, and implants
- Control strategies (e. g. for climbing steps)
- Design for everyday use (wearable 24 hours)

- Prevention of problems like infection, necroses, safety in case of accidents (e. g. no nerve damage)
- Overall functional stability concerning the reaction of the nervous system (e. g. spasm)

5. Final remark

If, in some years to come, paraplegic patients will be able to stand up, walk, and climb stairs, they will do so because of FES. And the device used will be an implanted one!

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Acknowledgement:
This work is supported by the Federal Ministry of Science and Research and the Austrian Research Foundation.

Improvement of seating comfort due to a new wheelchair seating system

W.-A. Weishaupt, Kiel (Fed. Rep. of Germany)

There are two major requirements behind the development of hand-propelled wheelchairs: handling and seating comfort. For handling it is very important to reduce the weight of the wheelchair to reach good maneuverability; the wheelchair should moreover be easy to transport and therefore easy to fold. These requirements and the associated technical solutions go against seating comfort, for which it is necessary to have decisive improvement of pressure distribution and optimum dispersion of body humidity. The efforts to combine these two requirements characterise the history of wheelchair development till today.

A seating system designed by the requirements of human anatomy and physiology has to take into account different body sizes of users, and therefore the seat with its proportions, its angles, and its profile has to fit the human anatomy. In the physiological area the seat has to have good pressure distribution, and good humidity and heat transportation.

It is relatively simple to find out whether seat proportions and angles are adapted to the human body. Investigation of physiological seating features, on the other hand, is more difficult. While the proportions and angles are dealt within literature (for example Bürdek, 1981, or Müller-Limmroth, 1982), tests are necessary for elucidation of the physiological needs concerning pressure distribution, that take the special wheelchair conditions into account.

To measure pressure distribution we built a test chair (Fig. 1) which gave us a real picture of a wheelchair in use. The test seat and the experimental arrangement do not have any influence on the test person's seating behaviour during the process of measuring. The measuring system consists of transducers mounted on the seat and backrest surfaces. 42 transducers were used on the seat and 49 on the back to measure the deformation values. This method is employed to determine the areas in which the body has contact with the support system, to be able to analyze the interface layer in use.

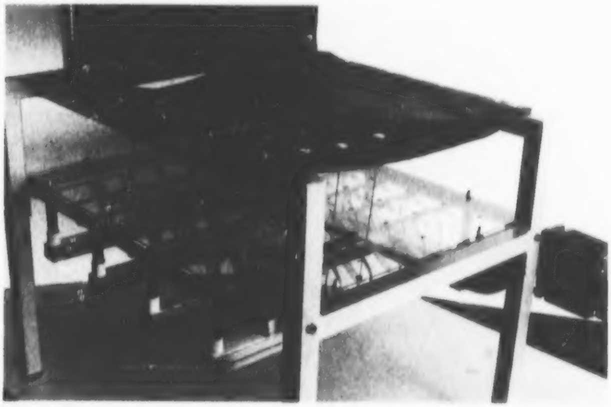

Figure 1

Measurement of material deformation serves to detect the true spherical alteration occuring in the seat surface during actual use. Thus, we obtain a more or less clear negative form of the seat and backrest. The result is a contour-line picture, as we know it from geographic maps, and this picture gives a direct value of the penetration of the human body into the seating system. Surface forces are determined by electrically and mechanically calibrated calculation of the stress values measured. The forces are recorded in N (Newton) and represented in delimiting lines called isodynes, and the resulting areas have equal surface forces.

This method presupposes two calibration processes. The first one is to determine the penetration values from the electrical values, and the second one is to store the penetration value as a force value with the aid of a calibration weight. The boundaries of measurement are the points of deepest penetration resp. equal planes of forces for measurement of strain. Our system for data acquisition works with strain gauges: the pressure caused by the human body deforms the surface of the support system and is transduced via surface sensors to bending stripes, which are the support material for the strain gauges. The results are recorded graphically, for the deformation measurements as contour-lines, and as isodynes for the force measurements (Fig. 2).

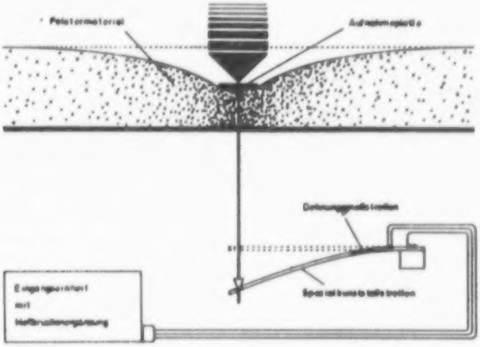

Figure 2

Let us take a look at a normal wheelchair seat: In Figure 3 the results of the deformation measured for seat and back upholstery can be seen. The delimiting lines represent areas of equal penetration. The standard hammock type seat shows an obvious tendency towards tunnel-shaped sagging with a strongly unilaterally emphasized tuberosity and a tendency towards the circular formation of the remaining contours to the deepest point in the seat depression (Fig. 3b). With the backrest, we can observe a contour shape deformation, which is a common signal of kyphosis in the earliest stage (Fig. 3a). No major differences exist between different test persons.

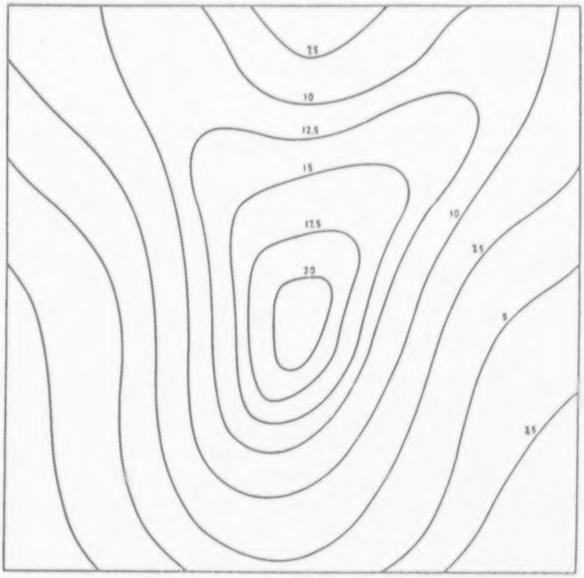

Figure 3a

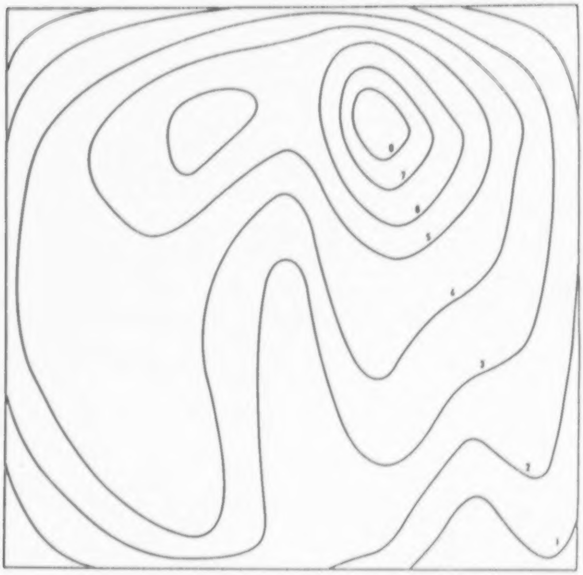

Figure 3b

Measurements of surface forces disclose the same overall trend (Fig. 4). The isodynes represent the delimiting lines, which seperate the areas with equal surface-forces: The standard hammock type seat shows a tunnel-shaped deformity producing a high pressure

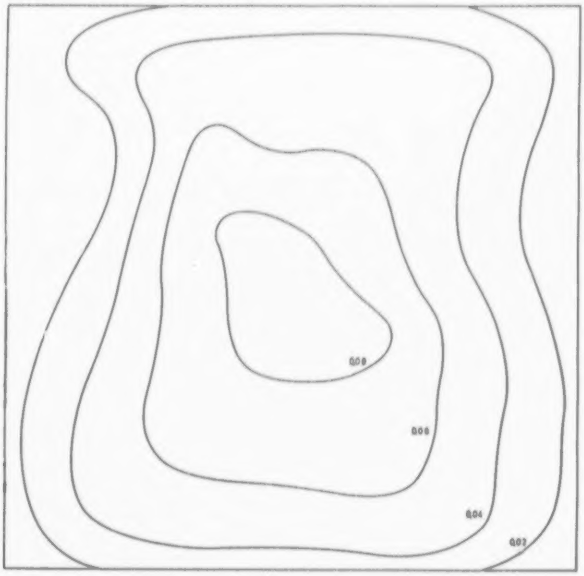

Figure 4a

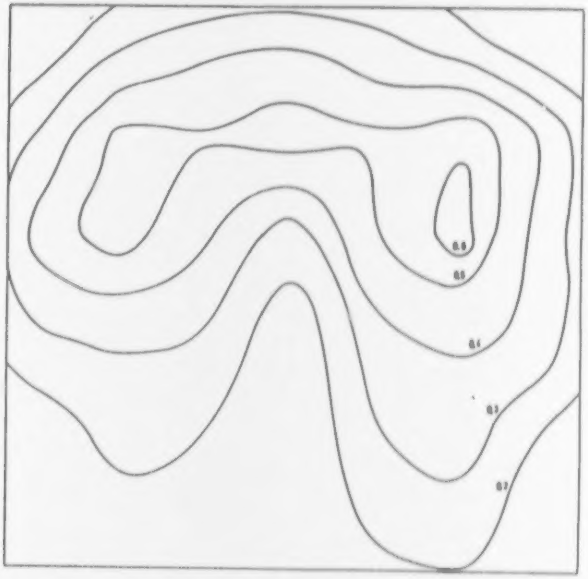

Figure 4b

zone in the region of the tuberosity, whereas the surface with considerable forces is relatively small (Fig. 4b). At the backrest, we can record a location for the main stress area (Fig. 4a) that is much too high.

All in all, it can be said that the conventional wheelchair seat has an obvious tendency towards tunnel formation or bottoming-out, which gives unsatisfactory pelvic support. Regarding the pressure distribution, it can be said that the stress lateral to the tuberosity region is too high. The interface between human body and seat system is not only a problem of pressure distribution, but also a problem of humidity and heat transport. Therefore, it is necessary to investigate how heat and humidity generated by the human body surface are transported through seat and backrest material. Two requirements have to be taken into account: (1) Removal of surface generated humidity. This is above all a problem of selected material, because the seat upholstery of a wheelchair has to fulfill various other criteria. (2) Transportation of heat and humidity through the upholstery. This is not only a problem of the selected materials but also of the thickness and the sequence of these materials.

The goal is to obtain as much transportation of humidity and heat as possible through the whole seat but without influence on the other requirements to a wheelchair seat such as: easy to fold, skinfriendly, wrinkle-free, washable, wear-resistant, flameproof. The investigation of wheelchairs with common technology shows the frequent incompatibility of these requirements.

This was the problem that had to be solved, and it was our principal aim to realize a new concept of wheelchair seat and backrest upholstery under the following conditions:

(1) The shape of wheelchair seat and backrest must guarantee anatomical body support and thereby suitable pressure distribution.

(2) The covering material still has to be easy to clean and water-resistant, but it also has to be permeable to air and vapours.

(3) The material used for seat and backrest should not have any negative effect on humidity transport.

With a new technique, sponsored by the Federal Ministry for Research and Technology, microporous leatherette covering material is now available. Microporous means essentially a special, patented process by which holes with a micrometer-sized diameter are achieved in the material by means of a high energy discharge at a density of approx. 1 million/m*m (s. Fig. 5).

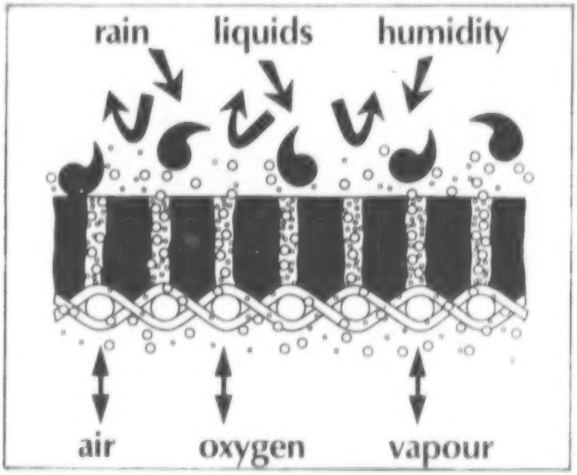

Figure 5

Temperature and humidity measurements showed positive results for the microporous leatherette, so we were able to continue working on the other requirements. With variation of thickness and shape of upholstery material, we obtained a seating comfort which has not been available in standard wheelchairs up to now. Looking at the deformation in Figure 6, we find a more symmetrical deformation of the seat (Fig. 6b), which allows easy identification of the points of contact of the legs, the shape of the posterior region, and the gradual slope to the tuberosity. The backrest (Fig. 6a) now shows a much more positive picture, with both strong lateral and upward support in the region of the pelvic ridge. Measurements of surface forces disclose the same overall trends. In the case of the seat, we find a symmetrical graduation of strain values over the entire surface. And in the backrest, a physiological support area in the region of the upper pelvic basin can be noted.

The differences between the common and the new upholstery are summed up in Figure 7. The deformation of the wheelchair seat is shown here in a perspective manner, and the graduation of pressure distribution is illustrated by different hachures. In Figure 7a deformation and pressure distribution of a conventional upholstery is illustrated, in Figure 7b we can see the new upholstery. It is obvious that common seats and backrests keep their hammock-like surfaces and have no adjustments to the body even under load. The areas with higher seating pressure are beneath the tuberosity, and regarding the backrest the maximum surface pressure occurs in the dorsal vertebra.

In the new seating system, maximum pressure is to be found under the tuberosity with uniform gradation over the entire seat surface. This, in turn, results in relief of pressure to the lateral regions of the ischial tuberosity. The backrest upholstery with special foam padding also helps in distributing back weight to the upper pelvic region, whilst decreasing uniformly outwards and laterally. Back support is thus shifted to the pelvic brim, the pelvis is straightened, and the spine is relieved of load. The upholstery is made of PUR-foam.

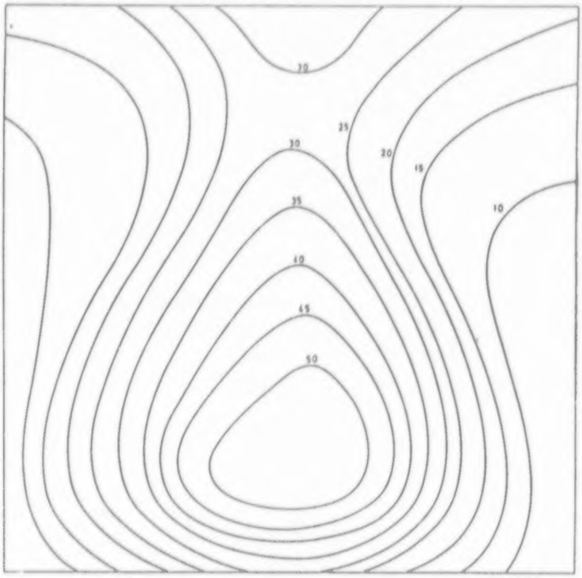

Figure 6a

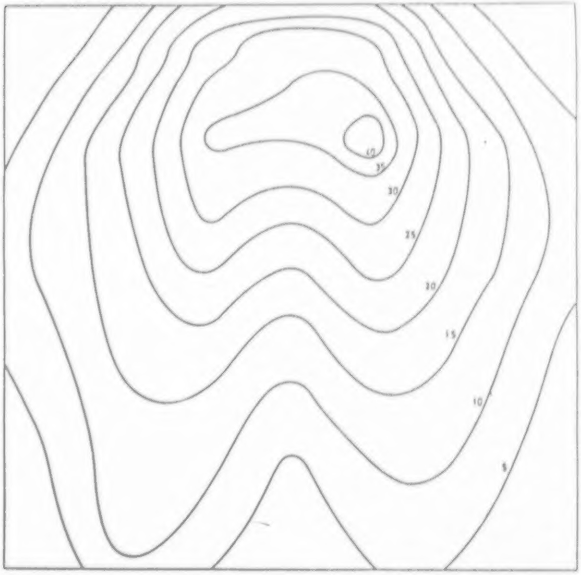

Figure 6b

Together with the microporous leatherette covering material and the macroporous holes under the seat, we reached acceptable humidity transport and air ventilation. In order to investigate the seating climate, we looked at two parameters: temperature and humidity. After tests with 6 persons the results shown in Figure 8 were obtained. Obviously, the humidity value on the ordinary wheelchair is not only higher but also has the tendency to increase. With the new upholstery, a saturation of under 70 % within 1 hour is found. The new seating system therefore is in the range of acceptable physiological values. Similar results can be found in temperature tests.

With the aid of these activities we reached a major advantage concerning seating comfort in wheelchair applications (Fig. 9). The different requirements, i. e. easy to fold and low weight; physiologically accommodating seating, waterproof, and easy to maintain; correct seating posture with decisive improvement in pressure distribution, have been fulfilled with the upholstery presented. It has thus been possible to combine good handling and good seating comfort.

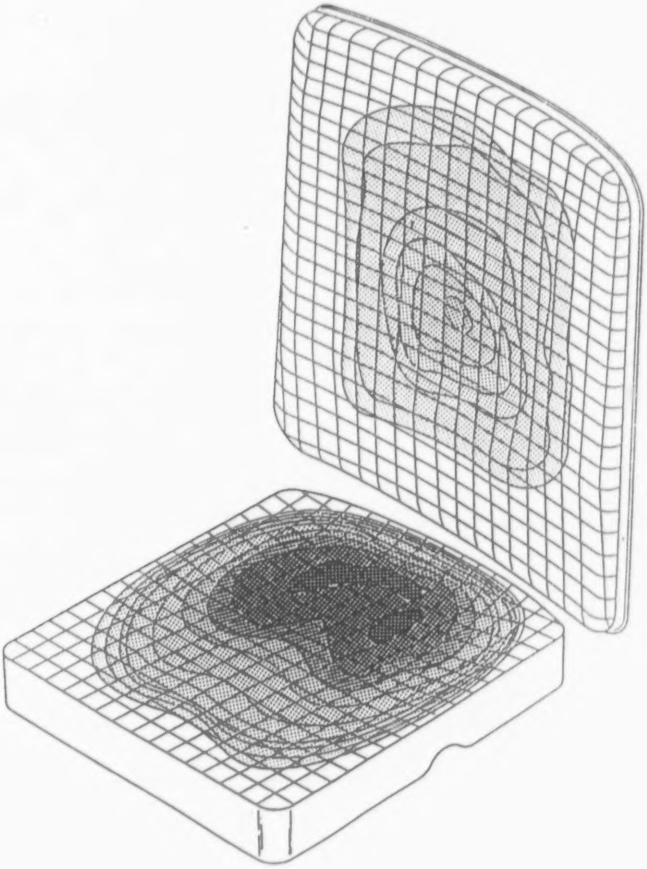

Figure 7a

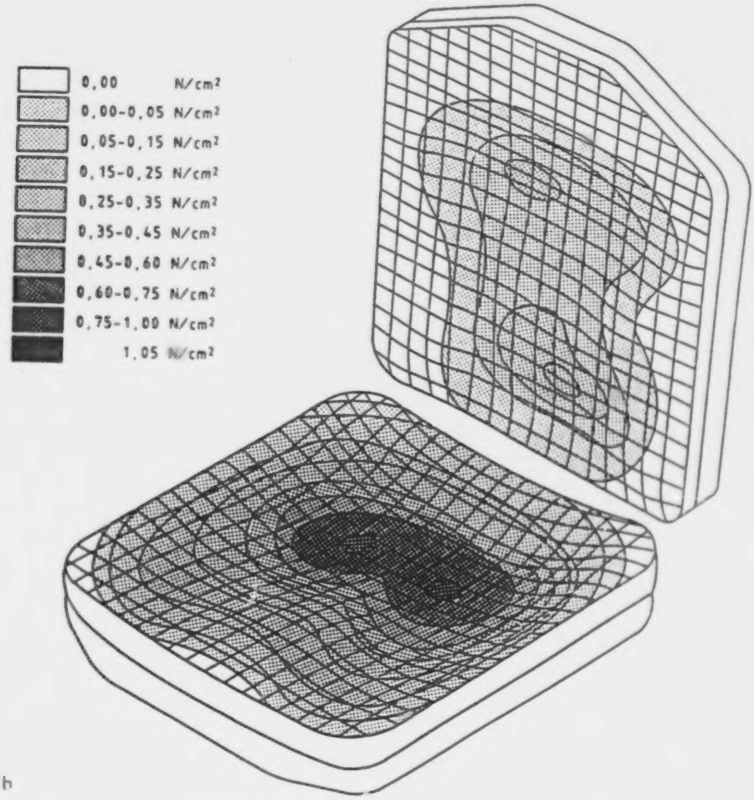
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Figure 7b

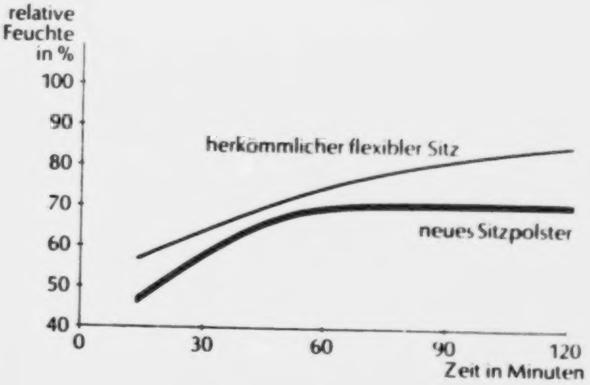

Figure 8

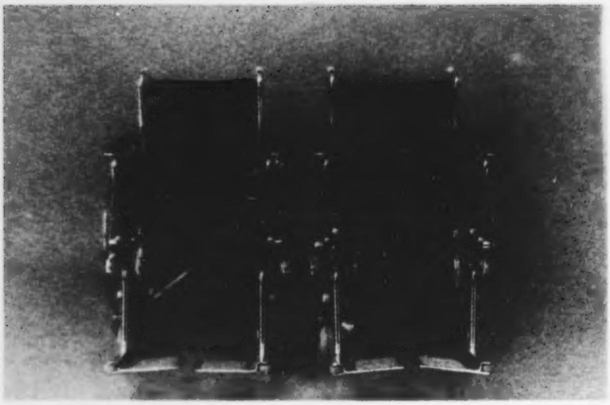

Figure 9

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Report on the proceedings of working group 2

J. Hughes, Glasgow (United Kingdom)

In the framework of group 2: "Use of prostheses, orthoses and technical aids," nine presentations and two prepared discussions covered the following areas:

- information/communication (2),
- wheelchairs and equipment (3),
- functional electrical stimulation in paralysis (3),
- airsplints in hemiplegia (1), and
- prosthetic/orthotic evaluation (2).

Naturally with such a diverse group of subjects, discussion ranged over a wide area. Most papers gave little emphasis to evaluation, but the theme was identified as deserving special attention and was separately discussed.

Evaluation may be defined as a comprehensive procedure which includes physical testing, functional testing and clinical testing. There was general agreement that present evaluation efforts are grossly inadequate in comparison to the vast proliferation of aids and the enormous sums of money spent in this field. An urgent need was expressed for evaluations to be carried out and findings to be made available to professionals and the disabled themselves. It was strongly felt that evaluation should be a prerequisite to prescription.

Reference was also made to evaluation and information dissemination to be carried out within the E.E.C. as part of the HANDYNET project. The International Society for Prosthetics and Orthotics was also identified as being active in collecting information on national evaluation programmes. It was deemed important that these groups should collaborate and work in this area as well as in the promulgation of standards within the International Standards Organization.

There was an urgent need for the development of internationally agreed protocols so that the results of national evaluations might gain international acceptance. Vocabularies and classification systems should be based on or be compatible with existing systems.

Group 3:

Stroke

Chair: Prim. Univ.-Doz. Dr. Franz Singer, Bad Schallerbach, Austria

What are the relevant clinical determinants to evaluate the results of rehabilitation after cerebral infarction.

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During a one-year period in 1983, a multicenter study was carried out with the intention of evaluating rehabilitation procedures among patients over 60 years of age. Epidemiological aspects were also considered.

In two rehabilitation centers, 843 patients were investigated, and treated with physical therapy. The sex distribution shows a slight prevalence of female patients. The clinical course was complicated by sudden death in 2.7 % of the test population, mostly due to pulmonary embolism or malignant arrhythmia. 6 % refused to participate in the study. One year after discharge from the hospital, 250 persons could be examined in a follow-up study in order to explore their ability to solve problems of daily living. In 10 general hospitals of Kassel, representative for the region Kassel City and Kassel Country, 699 patients sixty years and over with acute strokes were studied simultaneously. Lethality during the first 3 weeks of hospitalization was 37.1 %. An additional 17.5 % of the population died within one year after the stroke episode. 34.3 % of the population could be investigated one year after discharge, a number comparable to the number of reinvestigated patients from the rehabilitation centers.

A difference in age distribution between the groups of patients in the general hospital and the rehabilitation centers is obvious. Stroke is a disease of old people, and there is a distinct selection of younger patients who are referred to the rehabilitation centers. There is a clear difference between prognosis who will live and who will be cured. Like in previous investigations mentioned in the literature, we found that state of consciousness, urinary and fecal continence, severeness of hemiplegia are reliable prognostic criteria regarding early lethality. In order to evaluate clinical parameters for long-term prognosis of the functional condition, meaning improvement of all consequences of the neurological disorder, we analyzed the data of 250 patients who entered the follow-up study one year after treatment in the rehabilitation centers. The mean duration of the treatment in the rehabilitation centers was 9 weeks (median 8 and maximum 31 weeks). Different types of aphasia and degree of severity were found in 27 % of the population. 21 % of the patient showed more than one cerebral infarction.

More than 60 % of patients were admitted to the rehabilitation centers up to 6 months after acute stroke, but nearly one fifth of the patients were treated two years or later after onset of the disease. Medical status, findings of occupational therapists, physiotherapists and logopedists were registered in intervals of four weeks using EDP. Psychological data and case history details were also provided. A standardized treatment comprising individual physiotherapy according to Bobath, walking exercise, massage, electrotherapy, sometimes hydrotherapy, and speech therapy, as far as necessary, were administered. The frequency of occupational therapy was quite different in the two participating hospitals so that an average value of treatment is not reliable.

The functional changes from beginning of treatment in the rehabilitation center to discharge and finally at the follow-up examination after one year are illustrated by the ability to walk properly: most patients show an improvement of their initial handicap; the majority was also able to walk without personal help; 8 percent of the patients showed further improvements at the time of the follow-up examination.

About one third of all patients received continued physical therapy as outpatients. A lack of physiotherapy becomes apparent. There was a surprisingly large number of prescriptions for massage.

We tried to identify the essential clinical determinants which will provide reasonable prognostic criteria at a late phase of rehabilitation. For that reason an exact definition of the aim of rehabilitation had to be given. As you all know the ultimate aim of rehabilitation ideally is to obtain complete restoration of the impaired functions. In reality, the results are much more modest. We are glad if our patients will be able to perform most activities of daily living. The problem in this study was to deal with the large amount of information, and to convert it into reasonable statistical analysis.

Using chi-square test, we analyzed the change of parameters representing the activities of daily living depending on age, sex, time between stroke and rehabilitation, and case history. The whole group of patients was divided into subdivisions according to certain aspects, such as change of leg and arm function, and number of strokes. There are numerous correlations between factors mentioned before, like age, sex, and so on, and the parameters of daily living. Numerous factors influence the change of arm and/or leg functions in a complex manner. Thus, an individual prognosis appears to be impossible.

Assuming that the severity of the stroke not only predicts early lethality but also includes information about the long-term results of rehabilitation, two groups could be formed by means of an index ranging from 0 to 36 points. The clinical symptoms used are descriptive of the severeness of the neurological impairment and are known to be valid prognostic criteria for survival.

If we consider the group with the smaller number of points, i. e. those who have a better prognosis, only a few factors are seen to influence the change of activities of daily living until the follow-up examination. Comparing this result with the multitude of relations shown previously, it is probable that the parameters comprised in the above-mentioned index, on which the two groups are based, dominate the course of rehabilitation. This statement becomes much clearer in the group with the higher number of points, which is a high-risk group in terms of lethality. No correlations between the factors analyzed were found.

We conlude that the same clinical parameters responsible for early lethality are equally relevant in estimating the long-term rehabilitation outlook.

A follow-up study of stroke patients 5–6 years after their brain infarct

I. Wadell, Umeå, A. Kusoffsky, and B. Y. Nilsson, Stockholm (Sweden)

1. Introduction

The large number of stroke patients focus attention on the role of rehabilitation. Studies indicate that about 30 % of the victims live for 11 years or more after stroke, with mean survival exceeding 7 years (Anderson et al., 1977). It is therefore essential to develop and provide relevant prognostic instruments and rehabilitation programs, and to set realistic goals.

During the period 1978–1980, we studied 16 patients with hemiplegia due to acute brain infarct in order to investigate the relation between sensory deficit, changes in somatosensory evoked potentials (SEP), and recovery of motor function (Kusoffsky et al., 1982). It was our aim to identify a useful method for predicting sensorimotor recovery after stroke. Patients with transient symptoms and those over 70 years of age were excluded from that study. With the intention of evaluating the long-term prognostic assessment, we decided to reexamine these patients 5–6 years later and to use the same clinical and neurophysiological methods. We were also interested to see if the level of motor and sensory function had changed since the last examination performed 6 months after onset.

Many studies have reported on the long-term mortality after stroke (Sacco et al., 1982; Wade et al., 1984), but only few studies have elucidated the entire life situation for stroke patients several years after their cerebrovascular accident (Anderson et al., 1977). To get information about the intervening period, we therefore supplemented the previous tests with an ADL test and a structured interview concerning type of living, training opportunities, and quality of life.

2. Method

2.1 Patients (Table 1)

Information about the patient group was obtained from a county computer register. 5 patients had died, all as a consequence of another cerebrovascular accident. 1 patient could not be found as he had moved from this part of Sweden. 2 patients, both with aphasia, were not able to come to the hospital for the investigation. Thus, only 8 patients could be retested 5–6 years after their brain infarct. These patients were all males, their present age was 59–79 years (median 70). 4 had right-sided hemiplegia, 2 of them with aphasia, and 4 had left-sided hemiplegia.

2.2 Procedure

The same clinical and neurophysiological tests were performed as in the previous study (Kusoffsky et al., 1982). Motor control, touch and joint position sense in the upper and lower limbs were rated by a test score system devised by Fugl-Meyer et al. (1975) after principles proposed by Twitchell (1951) and Brunnström (1970). The neurophysiological examinations included recordings of cortical somatosensory evoked potentials (SEP) to electrical stimulation of the median and tibial nerves (Halliday & Wakefield, 1963). Responses from the paretic side were compared to those from the unaffected side. ADL function was evaluated with the Barthel index (Mahoney & Barthel, 1965). This score

Table 1: *Summary of patient data and results.*

Pat. no.	Sex	Age at onset	Paretic side	Apha-sia	6 months after onset						5–6 years later					
					Arm			Leg			Arm			Leg		
					Motor funct.	Sens. funct.	SEP	Motor funct.	Sens. funct.	SEP	Motor funct.	Sens. funct.	SEP	Motor funct.	Sens. funct.	SEP
1	M	62	Left	–	26	0	III	64	50	III	30	0	III	68	0	III
2	M	65	Right	+	97	100	I	93	100	III	not available					
3	M	64	Left	–	25	100	III	59	100	III	16	0	III	50	88	III
4	M	59	Left	–	100	100	II	100	100	I	not found					
5	F	69	Left	–	88	37	II	98	25	III	deceased					
6	F	66	Right	–	86	100	II	98	100	I	deceased					
7	M	69	Right	+	10	0	III	57	25	III	15	0	III	59	12	III
8	M	63	Right	–	96	100	I	100	100	I	97	100	I	96	100	I
9	M	69	Left	–	10	0	III	54	0	III	16	0	III	53	50	III
10	M	69	Right	–	100	100	I	52	100	III	deceased					
11	M	61	Right	+	12	0	III	41	0	III	10	0	III	50	12	III
12	M	62	Left	–	100	100	I	100	100	II	deceased					
13	F	58	Right	+	66	25	II	95	37	I	not available					
14	M	53	Right	–	38	100	I	79	100	I	40	100	I	75	100	I
15	M	69	Left	–	100	100	II	100	100	I	100	100	II	100	100	I
16	M	62	Left	–	58	100	II	50	100	I	deceased					

SEP type: I = normal. II = abnormal asymmetry. III = no response from affected side.
Motor and sensory function is expressed as percentage of normal function.

system is a weighed scale, ranging from 0–100 in 5 point increments, measuring performance in self care (feeding, bathing, personal toilet, dressing, bowel and bladder care) and mobility (transfers, ambulation, and stair climbing). A score of 100 does not imply normality but simply that the patient is functionally independent for most daily living activities.

The Barthel index does not include influence of social factors. Therefore we supplemented the ADL index with a structured interview containing questions on civil status, type of living, employment, leisure time activity, training and self-estimated quality of life. We also asked for symptoms related to possible reinfarctions.

3. Results

The results are summarised in Tables 1 and 2. In this follow-up study, we found that the SEP did not differ from the previous recordings performed about 14 days after the cerebrovascular accident. We saw no response from the affected side in five cases, normal symmetrical responses in two cases, and an abnormal asymmetry in one patient.

Table 2: *Selected re-test results.*

Pat no.	Present age	% total motor function	ADL Barthel index	Civil status	Type of living	Work	Spare time activity	Training	Quality of life
1	69	44	85	married	home	retired	active	bicycle hydrother.	good
3	70	28	70	married	service home	retired	non active	physiother. 2/w	adjusted to situation
7	76	31	70	widower	service home	retired	non active	none	adjusted to situation
8	70	97	100	married	home	half day	very active	golf, walk, swimming	good
9	75	29	65	married	service home	retired	non active	physiother. 1/w	bad
11	67	22	60	widower	service home	retired	non active	none	adjusted to situation
14	59	53	100	married	home	retired	very active	bicycle	good
15	76	100	90	married	home	retired	non active	none	adjusted to situation

When we analysed motor recovery separately in the arm, it was obvious that during the first three months after onset there were large individual variations in motor recovery, but after that time the motor function had stabilised (Figure 1). Motor function in the upper limb was not appreciably different after 5–6 years (Figure 2). A similar type of recovery was seen in the lower limb (see Table 1). The level of sensory recovery had not changed during the intervening 5–6 years, with the exception of patient no. 3 who had lost his position sense in the upper limb.

All patients got a rather high score on the Barthel index (see Table 2). It varied from 60 to 100 points, with a median value of 77.5. We found a correlation between the ADL index and the total motor function (arm + leg), as shown in Figure 3.

The patients with the highest ADL score lived at home (see Table 2), and 3 of them were active or very active in their leisure time (Figure 4). Those with a lower ADL score were generally non-active in leisure time. Patient no. 15 had a total motor function of 100 % and an ADL score of 90. In spite of this, he was non-active in his leisure time. We got the impression that this could be due to some perceptual dysfunction (Bjorneby & Reinvang, 1985) caused by a second stroke. 2 patients had been in contact with a physiotherapist more regularly.

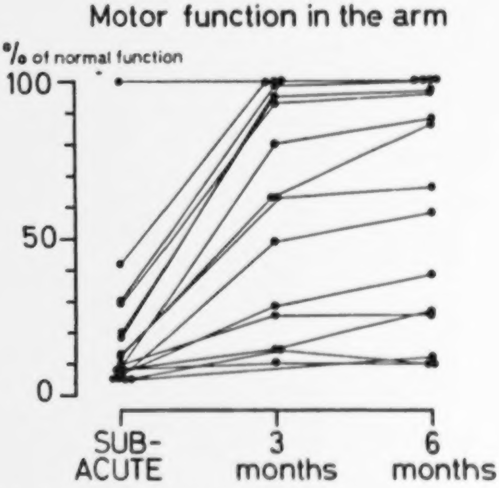

Figure 1: *Motor recovery in the hemiplegic arm (expressed as percentage of normal function) in the subacute stage and after 3 months and 6 months.*

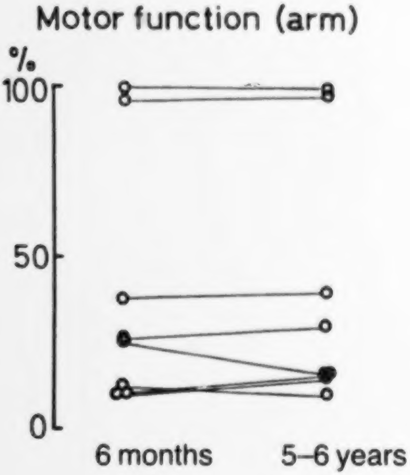

Figure 2: *Motor function in the hemiplegic arm (% of normal function) 6 months and 5–6 years after onset.*

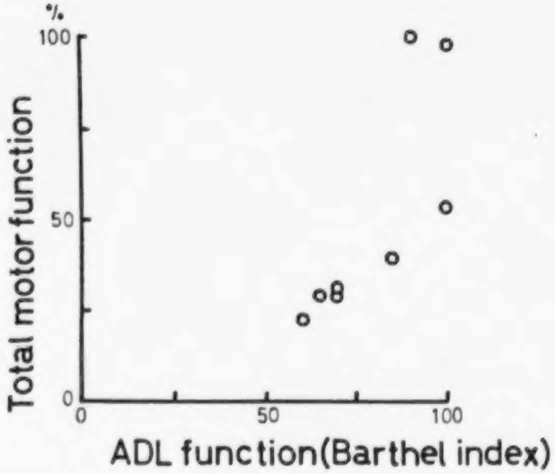

Figure 3: *Correlation between the ADL index and the total motor function (arm and leg: % of normal function).*

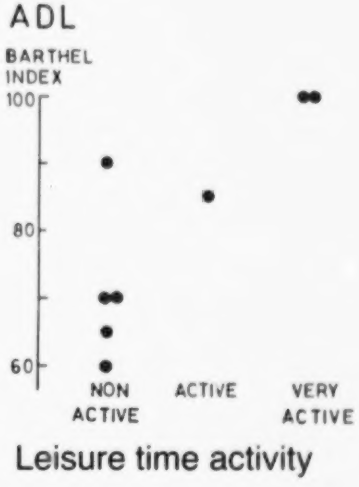

Figure 4: *Correlation between ADL index and the spare time activity.*

The self-estimated quality of life was good for those who lived at home and were very active during leisure time. Those who were not active estimated their quality of life to be adjusted to their situation, and only 1 patient considered his life quality to be poor. There was a correlation between quality of life and ADL index (Figure 5).

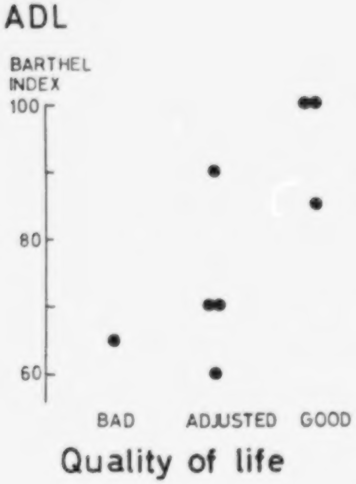

Figure 5: *Correlation between the ADL index and the self-estimated quality of life.*

4. Discussion

Due to the small number of patients, the present results do not allow any general conclusions. However, we would like to draw attention to some problems revealed in this study. In our first investigation, we found a correlation between the early SEP and motor recovery level at six months, especially in the arm. We now find that the SEP has not changed compared to previous recordings. Neither has motor function, evaluated by the Brunnström/Fugl-Meyer test, changed since the examination at six months poststroke. Loss of proprioception testd by SEP soon after the stroke, or even later (La Joie et al., 1982), can thus be regarded as a reliable prognostic sign also for long-term motor recovery. The question whether proprioception is necessary for motor function is still a subject under debate. Knapp et al. (1963) replicated the experiment of Mott and Sherrington (1895) and found that monkeys with a single deafferented limb could be brought to make use of this extremity in the conditioning situation only by increasing motivation and employing training techniques. This contrasted to the situation when both forelimbs had been deafferented and subsequently were used rather soon in activities like feeding. Rothwell et al. (1982) observed that there are some motor tasks that do not seem to require somatosensory feedback before they can be learned. Vision can compensate for loss of proprioception, but there are many motor skills to which vision cannot contribute. Proprioceptive afferent inputs seem to be especially important for the fine control of movement (Sanes et al., 1985). Smith et al. (1983) found that low motor function and low score of independence in self-care correlate to loss of proprioception. It has previously been noticed that motor recovery does not change very much after 6 months (Skilbeck et al., 1983). In this study, we found that neither does the level of sensory recovery generally change after six months.

The major aim of rehabilitation is restoration of functional independence, and measuring ADL ability is therefore appropriate. As pointed out above, all our patients got a rather high score on the Barthel ADL index. A value of 60 appears to be a pivotal score where patients move from dependency to assisted independence (Granger et al., 1979). It should be noted, however, that as little as 22 % recovery of total motor function gives an ADL score of 60 (patient no. 11), and that a 53 % recovery of total motor function gives 100 points on the Barthel index (patient no. 14). This last-mentioned patient had normal proprioception in both upper and lower limbs.

We found that all patients – irrespective of their degree of motor recovery – were extremely unilateral when performing the ADL activities. They displayed an excellent creativity in finding solutions to carry out the ADL tasks only with the unaffected arm. It is possible that they utilized the affected arm to a greater extent in the ADL situation at the time when they left hospital, thanks to the intensive occupational and physiotherapy treatment there. With time, in his own environment, the patient then finds that he performs the actual task much more conveniently and rapidly without using the affected, i. e. incoordinated and hypertone, arm and hand. For instance, patient no. 8 who had a total motor recovery of 97 % (93 % in the arm) had changed from right-handedness to left-handedness when writing and playing golf. This illustrates that stroke patients, like everyone else, follow the law of least resistance.

There is a difference between motor control evaluated in motor recovery tests, and movements which have to be learned or relearned to an automatic level in order to be useful in real life situations (Marteniuk, 1979; Whiting, 1980; Turnbull, 1982). However, few patients reach the normal automatic level. It may be that we have to find out those patients who are capable to stand the intensive training required for correct motor relearning.

2 patients received physiotherapy treatment in the intervening period, but we do not know the details of how this treatment was carried out. We think, however, that it is important to stress the patient's own responsibility and feeling of success. The tasks of the physiotherapist could have a more pedagogic orientation (Carr & Shephard, 1982). After having done an analysis the physiotherapist ought to correct the movements, as necessary, and then focus on strongly motivating the patient to continue his own training.

The interest in quality of life within rehabilitation represents a striving towards a comprehensive view of the patient and his situation. In the study presented, we utilized, together with objective data such as ADL function, type of living, and training resources, also a question about overall life satisfaction, expressed as quality of life. The 3 patients who experienced a good quality of life were all married, lived at home, had an active leisure time, and they were training with responsibility of their own for the progress achieved. 3 of the 4 patients with quality of life adjusted to the situation – but lower than pre-stroke – lived in service homes, the 4th (no. 15) lived at home. These four patients were not active in their leisure time. Only one patient (no. 9) estimated his quality of life to be poor.

Other authors (Ahlsjö et al., 1984) report that stroke patients may develop depression, and therefore have a low quality of life. In another study (Stensman, 1985) it is suggested that adjustment to mobility handicaps takes more than four years. After that period quality of life is nearly equal in both handicapped and non-handicapped populations. It is essential for the patient to cope with his disability (Trieschmann, 1974), and it is of greater importance how he can manage his new situation than how his real circumstances are.

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Prediction of arm and hand function recovery in stroke patients

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1. Introduction

The ability to make an early prediction of the expected recovery after stroke is of practical importance. It allows the patients and their families to make appropriate arrangements for the future, and enables the clinician to set realistic (time) goals for their rehabilitation.

Predictive variables may provide the research worker with criteria to stratify patients into prognostic groups before random allocation in treatment trials. This ensures more homogeneous groups, which means that smaller numbers of patients are needed for trials of treatment procedures.

This study sought to investigate the relationship between a wide range of clinical characteristics, as assessed during a routine clinical neurological examination (the predictor variables), and "motor" and "functional" recovery of the affected arm after stroke (the criterion variable).

2. Method

2.1 Subjects

A group of 111 patients admitted consecutively to the University Hospital, Nottingham, who were alive two weeks after onset of stroke were followed over a year. All patients were examined by the same physiotherapist, who was not involved in their clinical management.

Because of the duration of the study several patients died in the course of the follow-up. The number of patients assessed on each occasion was: 111 at two weeks, 92 at two months, 79 at six months, 70 at one year. Although maximum effort was made to follow each patient, some moved from the Health District, and it was also not always possible to collect all information because of severe communication breakdown, confusion, or mental deterioration. The prediction of outcome at six and twelve months was therefore based on the 58 patients with complete data at six months (56 at twelve).

2.2 Materials and procedure

The motor function of the arm was assessed with the Brunnstrom-Fugl-Meyer test (BRFM), full range 0 to 66 score (3). The functional recovery in the arm was assessed with the Action Research Arm test (ARA) developed by Lyle, full range 0 to 57 score (4). The clinical neurological examination was in accordance with the guidelines in: „Neurological examination in clinical practice" by E. R. Bickerstaff (1) and carried out by a research physiotherapist.

The following 24 patient characteristics or clinical variables were recorded: age, sex, pre-stroke ability, pre-stroke mental status, duration for stroke to develop, handedness, post-stroke mental status, overall motor ability, speech, side of hemiplegia, number of previous strokes, visual field loss, seventh cranial nerve, grading of spontaneous pain in the arm, grading of pain in the arm during passive or active movement, shoulder complications, resistance to passive stretch in the arm muscles, reflexes, exteroceptive sensation of light touch, proprioceptive sensation of passive movement, tactile hemi-inattention, stereognosis, co-ordination (finger to nose test, rapid hand tapping), and involuntary movements. The patients were re-examined at two weeks, two, six and twelve months after the onset of the stroke on the BRFM and ARA.

2.3 Statistical analysis

At a first stage, the quantified or dichotomised predictor variables, as assessed at two weeks, were each related individually to the outcome of the arm as assessed at six and twelve months by BRFM and ARA. Those which were non-significant, i. e. age, sex, pre-stroke ability, pre-stroke mental status, duration for stroke to develop, handedness, side of hemiplegia and stereognosis, were excluded from subsequent analysis.

Multiple regression analysis was then used to obtain a prediction equation, based on all remaining variables which showed a significant relation with the outcome variables. This was then simplified by deleting the independent variables that did not add substantially to the predictive accuracy.

3. Results

The prediction equation for the BRFM test at six months and twelve months from the clinical assessment at two weeks was:

$$\text{BRFM6} = (.65{*}\text{BRFM1}) - (2.14{*}\text{EXTPROP1}) - (5.85{*}\text{GRAD-P1}) + 31.9$$

$$\text{BRFM12} = (.53{*}\text{BRFM1}) - (3.11{*}\text{EXTPROP1}) - (6.14{*}\text{GRADSPP1}) + 37.6$$

The proportion of variation explained by the regression equation was 83 % at six months and 76 % at twelve months. The standard error of estimate was 9.4 and 11.5.

In a similar way, the multiple regression equation was defined for the ARA test at six and twelve months:

$$\text{ARA6} = (.44{*}\text{ARA1}) - (2.09{*}\text{EXTPROP1}) - (4.27{*}\text{OVERMOT1}) + 41.2$$

$$\text{ARA12} = (.33{*}\text{ARA1}) - (3.27{*}\text{EXTPROP1}) - (4.25{*}\text{OVERMOT1}) + 46.9$$

If the three highest loading factors were kept in the equation 71 % (at six months) and 66 % (at twelve months) of the variance could be explained with a standard error of 12.6 and 14.1.

4. Discussion

Patients' families often ask whether their relative will recover from a stroke. They need such information to make financial decisions and to prepare for the person's future care. Such decisions are made every day, but at present they are not based on facts (2).

Two general approaches to predicting long-term disability after stroke have been tried: The first identifies variables that relate individually to outcome. The second identifies a group of relatively independent items that collectively relate to the outcome.

Only one study (5) attempted to predict a patient's actual score (on the Barthel ADL scale) at a fixed time (six months post onset of stroke) from a clinical assessment shortly after stroke. Comparison between the two studies is not possible because arm function is not an important contributing factor in the outcome on the Barthel index. This study confirms the finding of Wade (5) that only a few variables seem necessary to produce a prediction equation. If applied in clinical practice, this could save much time in the evaluation of stroke patients.

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Visual control of arm movement in the stroke patient

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1. Introduction

In the normal, healthy individual, studies on how actions are controlled have demonstrated that continuous visual monitoring is not always essential (Carlton, 1981). In a simple movement, such as a reach, vision has been found to function primarily in a feedforward manner prior to execution of the act, furnishing information concerning the nature of the target and its spatio-temporal relationship to the hand. Vision only enters into the execution phase if fine adjustments are needed as the hand homes in on the target (Jeannerod & Prablanc, 1983). One has only to observe the actions of a stroke patient to realise that this is not the case following a CVA. Movement is visually monitored at all times during execution, and patients are typically encouraged to do this by therapists.

Although the importance of vision is universally acknowledged in rehabilitation literature, little experimental work has been conducted to establish how important it is, and how it functions. This paper describes one out of a series of experiments (Lough, 1984) designed to examine these issues.

2. Method

Subjects: 4 stroke patients, 3 right-side affected and 1 left-side affected, plus 1 normal control (aged 64) took part in this experiment. The mean age of the patients was 66 years (range 55–72 years), and the mean time post-CVA was 5.25 weeks (range 3–7 weeks). None of the patients presented perceptual or comprehensional difficulties.

Apparatus and procedure: The experimental set-up is depicted and diagrammed in Figures 1a, b and c. The task consisted of sliding a cradle along a track between designated target points as defined on a sheet of perspex mounted above the track. The cradle was wired up to

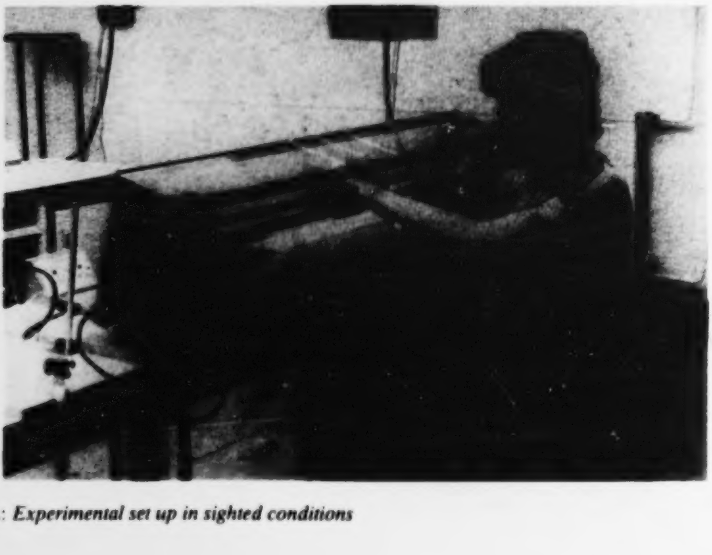

Figure 1a: *Experimental set up in sighted conditions*

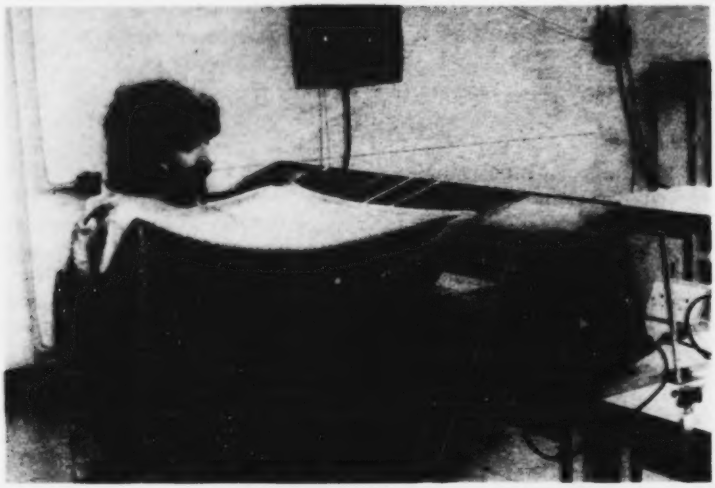

Figure 1b: *Experimental set up in unsighted conditions*

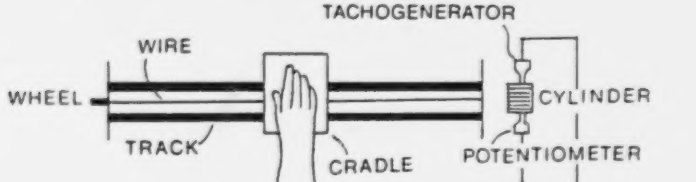
TACHOGENERATOR
WIRE
WHEEL
CYLINDER
TRACK
CRADLE
POTENTIOMETER
biceps electrode
HAND SWITCH
triceps electrode
amp
oscilloscope
amp
fm tape recorder

Figure 1c: *Schematic representation of the experimental set up*

a potentiometer and a tachogenerator, the outputs of which fed into two inputs of a four channel FM tape recorder. In this way, positional and velocity changes of the cradle were recorded, and the characteristics of the arm movement driving the cradle were thus captured. Since the required movement primarily involved action about the elbow, surface electrodes were placed on the biceps and triceps muscles, and their activity was also recorded.

Two situations were used for carrying out the experimental tasks. In the one depicted in Figure 1a, the subject could always see both his arm and the cradle as the targets were mounted on transparent perspex. In order to assess the effect of vision on motor control, the second situation, shown in Figure 1b, was devised as a non-visual set-up, involving screening off sight of the arm and cradle with occluders, whilst retaining visibility of the targets. The complete experiment involved comparison of the performance of the patients affected arm, the unaffected arm and the normal subject's arm across conditions which varied (direction of movement (flexion/extension), movement distance (10 cm/20 cm), and sight of the arm (sighted/unsighted)).

3. Results

Several measures were calculated from the raw data:

(1) Constant Error. This was obtained from the position record and represents the accuracy of movement with respect to the target position, taking into account the sign of any error.

(2) Mean Velocity. Obtained by dividing the movement distance by the movement time.

(3) Mean Submovement Distance. This was derived through a combined analysis of the position and velocity traces. Submovement analysis consists of partitioning the trajectory into its component submovements on the basis of the number of peaks present in the velocity profile (Brooks, 1974). Typically, this is used to assess the degree to which movement is under either preprogrammed or continuous corrective control (Jagacinski et al., 1980; von Hofsten, 1980). In normal adults performing a simple aiming task, the majority of the movement trajectory is encompassed within one velocity peak or submovement (Fig. 2). However, when the velocity profile produced by a stroke patient's affected arm is examined, there are usually several peaks, indicating the movement to be halting or jerky (Fig. 2). In order then to assess the smoothness or quality of movement, mean submovement distance was calculated by dividing the distance travelled on each trial by the number of peaks in the velocity profile, thus evaluating the degree to which movement could be conducted in a preplanned manner.

(4) Triceps and Biceps Activity. The criterion adopted for deciding when a muscle was active, was when its activity rose beyond two standard deviations of its measured resting level. The amount of time the muscle was active was then calculated as a percentage of the movement time.

Figure 2 illustrates a general finding: Movement of the affected arm is slower and not as smooth compared with unaffected and normal arm performance. This was confirmed in statistical analysis of the experimental measures using analysis of variance on each measure individually for each subject. The results indicated that the differences between the affected and unaffected arms were in large part due to the poor performance of extension as compared with flexion. This was a consistent finding across all the measures, and in presenting the data it is this result which the rest of this paper focuses upon. The five graphs in Figure 3 illustrate individual subject means on the measures discussed above. They compare the performance of flexion and extension of the affected arm to the 20 cm target across the two visual conditions.

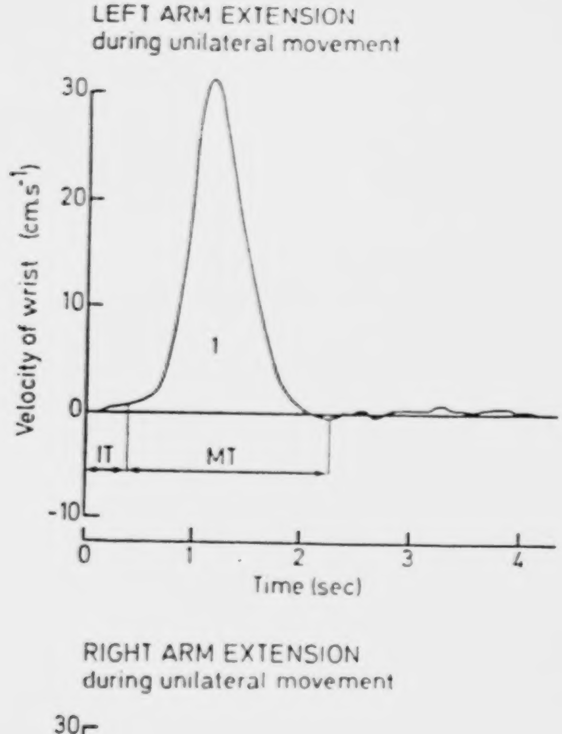

Figure 2: *Velocity profiles of movement of the wrist during midline extension of the unaffected (top) and affected (bottom) arm of a stroke patient (from Lough, 1984).*

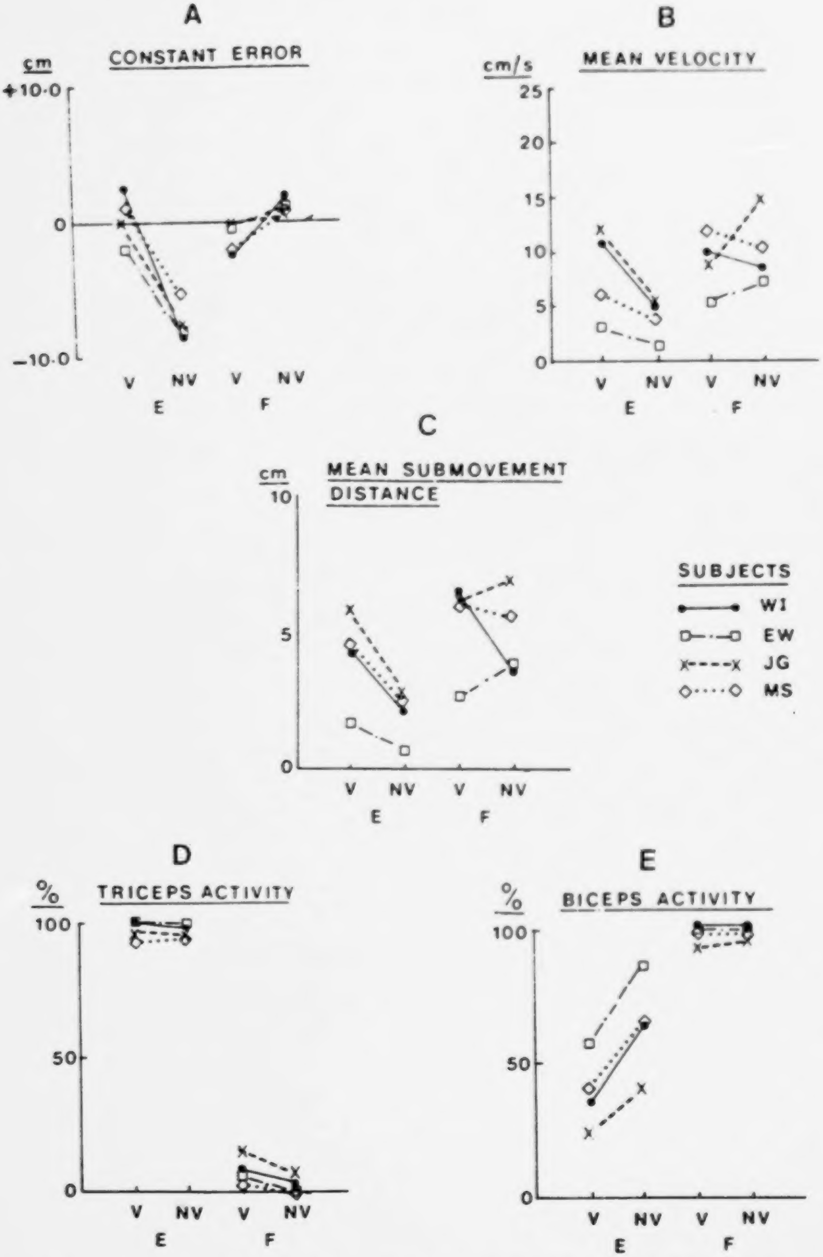

Figure 3: *Individual patient means for affected arm extension (E) and flexion (F) to the 20 cm target, under sighted (V) and unsighted (NV) conditions.*

Withdrawal of vision has little effect on the accuracy of flexion, which remains reasonably accurate (Figure 3A). On the other hand, accuracy of extension suffers significantly in all four patients in that they all undershoot the target. Similarly with mean velocity (Figure 3,B) and mean submovement distance (Figure 3,C), the patients show a trend to reduction on both when the arm cannot be seen. The effect on flexion is inconsistent. There is also a difference in EMG activity between flexion and extension when sight of the arm is prevented. When acting as an agonist during extension (Figure 3,D), the triceps is active throughout the movement. During flexion, when it is the antagonist, it is barely active at all. Also, there are no differences between the two visual conditions on either of the movements. In a similar fashion, the biceps as an agonist is active at all times during flexion regardless of whether the limb can be seen or not (Figure 3,E). However, when functioning as an antagonist during extension, the picture is markedly different. Instead of remaining reasonably silent, the biceps exhibits a fair degree of activity. Additionally, it would appear that this activity can be visually modulated, since it is reduced when the experimental situation permits visual monitoring.

In summary, visual monitoring of affected arm extension affords more accurate, faster and smoother movement, with a reduction in biceps cocontraction.

4. Discussion

In the literature on normal motor skills, the presence of more than one submovement in the velocity profile is typically attributed to a correcting process. It however is questionable whether this explains the jerky nature of affected arm extension. It seems more likely from examination of the EMG data that the jerkiness is due to interruption rather than correction. The high amount of biceps activity during affected arm extension is paradoxical bearing in mind that, as indicated by flexion, slow movements typically exhibit very little antagonist activity (Wallace, 1981). Contraction of the antagonist has been found to be necessary only in fast movements when the viscuo-elastic forces brought about by its stretch are insufficient to counteract the torque produced by the agonist (Lestienne et al., 1979; Marsden et al., 1983). Data on normal subjects indicates that the central nervous system can to a large extent pre-plan for the necessity of antagonist contraction. Instructions regarding amplitude and speed of movement have been shown to affect whether or not the antagonist fires, and if so, to what degree it is active.

In this experiment, the presence and persistence of biceps activity during extension, concomitant with a low mean velocity and discontinuity, may be viewed as a failure in the normally flexible control of antagonist function. Given that the triceps remains active throughout extension, it is reasonable to propose that the jerky nature of the movement results from interruption by the active antagonist. Undesirable biceps activity could also explain the inaccuracy of extension. All four patients undershot the target. This could be an indication that antagonist activity led to a premature cessation of movement.

5. Conclusion

In answer to the questions posed at the start of this paper, the results presented illustrate the potential of visual information to improve performance of the affected arm. Also, the experiment itself demonstrates a useful approach to examining issues pertinent to the treatment of stroke.

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Predictive factors in stroke outcome and implications for intervention

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It is impossible to cure a severe apoplexy and not easy to cure a mild one (Hippocrates 460–355 B. C.

As usual Hippocrates was right – but what one would like to know is which patients are likely to do well, which do badly? How can we help to improve matters? Obviously, one would like to know this as early as possible, so that a realistic prognosis can be given and plans made appropriate to future needs of the patient.

We assessed (Henley et al., 1985) two hundred consecutive patients admitted to University College Hospital with a diagnosis of recent strokes to determine whether it was possible to predict, during the first few weeks after the onset of the illness, the likely functional outcome after a year. 12 % of our original sample died before the first assessment was completed. Of the remaining 172 patients, slightly fewer men than women, 13 % were under 60 years of age, 60 % were between 61 and 80, and 27 % were over 80 years old.

Patients were assessed during the second week post-incident by a multidisciplinary team. This consisted of physical and psychological examinations by a doctor, a physiotherapist and a psychologist respectively, and an assessment of activities of daily living by an occupational therapist. Standardised tests such as parts of the Wechsler Adult Intelligence Scale and the Motor Club Scale (Ashburn, 1982) for motor and sensory function were used whenever possible.

For other factors, such as mood and motivation, we had to devise our own scales, as none were thought to be appropriate. Motivation towards treatment was assessed by the research physiotherapist, partly through discussions with the nursing and treatment staff. The assessment of mood posed particular problems. Standard self-report instruments, which were in any case of doubtful reliability, were clearly not suitable for confused or dysphasic patients. We also felt the negative content of many of the questionnaire items might prove distressing to emotionally labile and vulnerable people. It was finally decided to rate patients on a 5-point scale from „very depressed“ to „very cheerful“ on the basis of appearance and behaviour and, whenever possible, verbal content.

Data obtained were correlated with 4 outcome grades at a year. These were as follows:

I. Personal independence with or without domestic assistance.
Only a few patients in this group returned to work, due to their age and poor employment situation.

II. Personal assistance in own or relative's home.

III. Institutional care.

IV. Death.

Results showed that age was the most important factor regarding survival, and, as other workers, we found early death to be related to prolonged coma, conjugate gaze deviation, confusion, and incontinence. Some factors that were later found to be significant for outcome were age related. The difference between results for the total sample and the largest age selected group, 61–80 years, was not statistically significant.

Good prognostic signs included such social factors as having a living spouse, previous independence, and frequent social contacts. On physical assessment a high score on the Motor Club Scale, and in particular the ability to sit unaided during the 2nd week post-stroke, correlated with a good outcome.

Surprisingly, transient ischaemic attacks preceding the stroke were a favourable sign. A past history of diabetes, treated or untreated hypertension, peripheral vascular disease and a wide range of previous medication for various symptoms, in particular musculo-skeletal problems, showed no significant correlation with *outcome* in this study, although some of these may well have been significant factors in the aetiology. We also looked for a possible effect of major life events having preceded the stroke but found no significant relationship.

For technical reasons, computerised tomography was only carried out on one-third of our subjects, so that we feel unable to draw any valid conclusions from this. However, 63 % of the patients showing cerebral atrophy on scanning died during the following year or needed full institutional care.

Higher cerebral functions seemed to us the most significant for prediction of outcome. Ability and willingness to co-operate with assessment procedures, alertness and moderate cheerfulness were highly significantly related with a good prognosis. So were good scores on the Wechsler sub-tests for visuo-spatial ability and verbal learning tasks. Positive motivation towards treatment was found to be more significant than the intensity or early start of treatment. Most patients, in fact, received early, daily treatment consisting of positioning, passive movements and chest physiotherapy, but this was impossible to quantify.

Speech problems were not a determining factor regarding discharge into the community; 50 % of our dysphasics returned home.

Patients who had a poor outcome were, at 2 weeks post-incident, unable or unwilling to co-operate with the assessment procedure; they had difficulty in concentrating and were frequently depressed and at times drowsy. Swelling of the affected hand, hypotonicity, especially of the lower limbs, and faecal incontinence were also poor prognostic signs.

Higher cerebral functions were again highly significant predictors. Of patients showing perseveration, 50 % died within a year, and 20 % needed prolonged custodial care, whereas only 1 patient in the best outcome grade showed perseveration. Two thirds of the patient showing confusion at 2 week died or needed prolonged institutional care.

Although sensory neglect was at times difficult to ascertain, patients without apraxia, agnosia or sensory neglect at 2 weeks, generally made good recoveries.

Our results show an association between positive mood and good outcome. It may be that a more positive mood predisposes to greater motivation for treatment, which in turn contributes to a favourable outcome. Recent findings suggest (Robinson & Price, 1982) that as many as one third of stroke patients suffer from depressive disorders, which at present go largely untreated. If this is so, psychological intervention aimed at alleviating depression might well lead to increased benefits from physical therapy. Other means for improving mood and motivation are being tried. Clear goal setting by discussion with individual patients and their families, with continuous checks and revision of goals at short intervals as progress is made, may be helpful and is reinforced by early home visits, weekend leave, trips to the shops, pubs and places of entertainment.

Patients frequently "forget" or suppress early, severe disability and practical problems of daily living. Serial videos and diaries kept by patients in writing or on tape make slow progress more obvious and act as encouragement to further effort.

Sensory problems, and especially sensory neglect, seemed to us to respond poorly to standard methods of treatment. We tried small bells and brightly coloured materials attached to the affected side to try and attract patients' attention, without much success. Recently, a neuro-muscular stimulator has been used in our Unit to increase proprioceptive feedback at the same time as using visual stimuli – we are awaiting results.

Group treatment may have some value – perhaps partly due to patients becoming more aware of other people's abilities and disabilities. Competitiveness may also play a part, although this is not deliberately encouraged.

Table 1: *Significance of variables in predicting outcome*

Significance: **$p < 0.01$**	*Significance:* **$p < 0.05$**
Age	
Marital state	Sex
Contacts	Weight
Previous life style	T I A
Duration of coma	Circumstance of CVA
2 weeks post-incident	
Level of consciousness	Conjugate deviation
Confusion	Swelling of foot
Incontinence	Tone
Speech abnormality	Verbal learning ability
Visuo-spatial ability	
Mood state	
Perseveration	
Swelling of hand	
Isolated upper limb (U. L.) movement	
U. L. sensory-motor ability	
Isolated lower limb (L. L.) movement	
Superficial sensation	
Stereognosis	
Sensory neglect	
Functional movements	
Sitting balance	
Apraxia	
Agnosia	

We have recently started to use the Peto method of Conductive Education. This is in some ways reminiscent of a computer program. Complex activities, such as getting up from the floor, are broken up into simple, small steps to be carried out in sequence on the command of the conductor. As the movements are carried out and repeated, conductor and participants say in unison what they are doing, often keeping time by counting. Auditory, together with visual feedback appears to improve performance in this situation, and even dysphasic patients often manage surprisingly well. Although this method needs, initially, a somewhat authoritarian therapist, and although we were doubtful whether our patients would take to it, they now look forward to their Peto Class (and probably benefit from it).

In summary: We were able to identify, shortly after a stroke, a number of social, psychological and physical factors correlating significantly with final outcome (see Table 1). A further study to validate these findings is in progress.

It seems to us that in rehabiliating stroke patients it may be helpful to assess and, if possible, aim to modify higher cerebral functions rather than concentrate on purely motor activities by means of physical therapy.

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Late rehabilitation results of adult hemiplegic patients

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The assessment of late results of neurological diseases in general, and of hemiplegia in particular is difficult due to the complexity of the symptomatology. Speech is disturbed, sphincters become relaxed, behaviour is often irritable or depressed, the motor ability of a hemiplegic person is disturbed, and so on. There have been numerous attempts to assess hemiplegia by physicians pointing out those disturbances which fall into the area of their specialities. Even some of us have made hemiplegia assessments (1, 2, 3). The accurate assessment of acute cerebrovascular accidents (ACVA) is indeed complex, as studied in detail in Rauschelbach & Jochheim's latest book (4).

On the other hand we know that a great many sequelae of acute cerebrovascular accidents cure spontaneously. Then, how should we determine whether it was the rehabilitation treatment or the normal course of the process, which lead to the final result three years after occurrence of hemiplegia. It is possible that, thanks to the general use of scanning with computer tomography, a more accurate localization and diagnosis of cerebral accidents, and therefore a prognostic potential, could be developed in the near future. However, many other circumstances will always have an impact, e. g. previous illnesses of the patient, his prior habits, his will to submit to the rehabilitation treatment, the suitable medical treatment of the cerebral accident, early onset of treatment and its more or less correct implementation.

1. Generalities

Hemiplegia is important because of incidence and seriousness, mortality and sequelae.

1.1 Frequency

According to Heman (5), there are 152 ACVA per 100 000 population per year. Whisnant (6) estimates 200 ACVA per 100 000 population per year. All these figures are relative. In Guadalajara province, with a population of 155 000 people, we have observed 474 ACVA cases in 3 years, which amounts to a total of 158 strokes a year. This means about 100 ACVA per 100 000 population per year. But we should not forget that light transitory episodes are difficult to include in statistical studies when they are cured without hospitalization thanks to a family doctor's treatment. Our statistics cover only those who were admitted to the hospital. Nearly all authors, however, agree that it is the most frequent neurological disease.

1.2 Mortality

The mortality rate is high after hemiplegia of vascular origin in the long run. It depends firstly on how much time elapses until the patient comes under medical treatment. According to some authors, it varies between 25 and 70 % within 5 years. Our checkup mean was 4 years and 9 months, and the rate was 33 %.

1.3 Age (Table 1)

Age varies a great deal depending on in- or exclusion of cardiac embolism. Our report includes a 26-year-old female with this etiology. In general, patients were between 45 and 85 years of age, with a high predominance of the age group between 65 and 79.

Table 1: *Age distribution in % (N = 300)*

Age	
91	1 %
85–89	2 %
80–84	13 %
75–79	23 %
70–74	27 %
65–69	20 %
60–64	7 %
55–59	1 %
50–54	3 %
39	2 %
26	1 %

(Mean: 72.3 yrs.)

1.4 Sex

The predominant sex in our report was female (55.3 %). We believe this fact to have no special significance and to be related to the general population of the different regions studied.

1.5 Profession

Housewives were most frequently affected. Undoubtedly, this must be related to the pressure in the family, everybody leaning on her. The next greatest frequency was observed among the retired.

2. Background

Our study concerns the assessment of 300 patients having suffered hemiplegia, who underwent rehabilitation treatment directly supervised by us. The time elapsed after the event was never less than 3 years, in one case 7 years and 2 months. We first explored any known background data, then studied the different items found.

Diseases found most frequently were cardiovascular, respiratory, neurologic, digestive, and skeletal. The skeletal diseases were surely related to the age group in which strokes occur and the progressive degeneration of the locomotor system with age.

2.1 Cardiorespiratory impairments (Table 2)

Heart complaints were the most frequent antecedents. Arterial hypertension, different types of arrhythmia, and acute infarct of the myocardium were common. The frequency order is once more in relation to the advanced age of our patients.

Table 2: *Cardiorespiratory antecedents*

Arterial hypertension	38 %
Cardiac arrhythmia	15 %
Cardiac thrombosis	1 %
Cardiac embolism	2 %
Pulmonary obstructive disease	5 %
Valvular diseases	7 %
Cardiac insufficiency	9 %
Acute myocardial infarct	8 %
Myocardial sclerosis	3 %
Arteriosclerosis	3 %

2.2 Neurological history (Table 3)

The neurological antecedents were extremely important for the outcome of rehabilitation treatment, since they usually involve motor, speech or sensory impairments, which were superseded by the subsequent hemiplegia. Prior thrombotic or embolic cerebral accidents were the most frequent. But we were mostly impressed by the presence of three facial paralyses reported as peripheral in the clinical histories, while they were likely central.

Table 3: *Neurological antecedents (in 24 % of N = 300)*

Thrombotic cerebral accident	13 %
Embolic cerebral accident	12 %
Headache	3 %
Convulsions	2 %
Peripheral facial paralysis	1 %
Trigeminus neuralgia	1 %

2.3 Digestive history

It is difficult to establish the relationship to hepatic impairments once a stroke occurs. But the higher incidence of ictus in nervous persons suffering from peptic ulcer, high digestive hemorrhage, or colic diverticulosis is understandable.

2.4 Skeletal history (Table 4)

If former illnesses of the locomotor system, especially forms of arthrosis, had already affected the function of the limbs, then hemiplagia affects an already impaired individual whose later rehabilitation will present serious difficulties.

Table 4: *Skeletal antecedents (in 20 % of N = 300)*

Lumbar arthrosis	15 %
Cervical arthrosis	4 %
Dorsal scoliosis	4 %
Dupuytren contracture	3 %
Gout	3 %
Coxarthrosis	2 %
Rheumatoid arthritis	2 %

2.5 Urologic history

The predominance of prostatism compared with infections or any other involvement was striking. This fact is also related to age.

2.6 Ophthalmic history

We noticed the previous presence of cataracts and glaucoma in quite a few cases. Naturally, impairment of such an important sense organ worsens rehabilitation prognosis.

2.7 Endocrine history

Finally, we want to point out that there were 24 cases of diabetes prior to the ictus. Diabetes worsens the prognosis of rehabilitation, above all for its effect on infections and the healing of ulcers caused by decubitus.

3. **Etiology** (Table 5)

We try to determine the etiology of hemiplegia in our patients. It is difficult but since CAT came into existence, we believe it is possible for the first time. Ischemia predominated clearly in our patients, followed by embolism and hemorrhage.

Table 5: *Etiology*

Ischemia	53 %
Hemorrhage	5 %
Embolism	8 %
Thrombosis	1 %

4. **Localization of the lesion** (Table 6)

We have attempted to localize the cardiovascular process by means of both neurological examination and the use of CAT:

- More than 50 % of the focuses were localized in the middle cerebral artery through neurological exploration. The localization of the neurological focus could not be determined in 25 % of our patients.
- By means of CAT, the subarachnoid or intraparenchymatous character of hemorrhages can be established in a more satisfactory manner. They were equally frequent, but lower in incidence than the cerebral hemorrhagic infarct. The affection of the middle cerebral artery decreased compared with the neurological exploration, showing instead the frequency of the vertebrobasilar localization.

Table 6: *Anatomical localization of the focus by CAT*

Subarachnoidal hemorrhage	10 %
Intraparenchymal hemorrhage	10 %
Hemorrhagic cerebral infarct	20 %
Cardiac embolism	18 %
Middle cerebral artery	15 %
Vertebro basilar artery	12 %
Without pathology	9 %

5. Initial symptoms

Neurological involvement comes first:

- In 69 % of the cases studied, onset of the clinical condition was sudden, with 25 % of patients falling to the ground; quite often there also was sphincteral incontinence.
- Both the right and the left side were affected in similar frequency.
- Hemiparesis predominated over full hemiplegia.

- Incontinence affected more than a third of the individuals.
- Sensibility decreased in almost one third of the patients; hyperesthesia was rarely present.
- Osteotendinous hyperreflexia was present in 40 % of the patients. Babinski was positive in more than one third of patients.
- Speech was initially disturbed in 50 % of patients (Table 7), naturally mostly in those with right side hemiplegia; but it is surprising that aphasia was present only in one third of patients with right side hemiplegia, which usually affects the left hemisphere.

Table 7: *Initial language alterations*

Anarthria	24 %
Aphasia	41 %
Right hemiplegia with aphasia	34 %
Left hemiplegia with aphasia	7 %

The lab findings were not very significant, glucose, urea and high cholesterol were found as frequently as in healthy individuals of the same age.

The ECG was normal in 62 % of the patients. The most frequent disturbances were blockades, arrhythmias after auricular fibrillation, and extra systoles, which often combined in the same patient. The EEG was normal in nearly 14 % of the patients. Two types of phenomena could be observed with almost similar frequency: generalized wide irregularities, which are also very frequent in healthy subjects of that age; and focal irregularities, generally localized at the temporal lobes.

Lumbar puncture was hemorrhagic in 80 % of the patients.

6. Clinical development

After a few days, a stable clinical stage is established, characterized by hyperreflexia with Babinski positive in 50 % of the patients. In 19 % of the cases, the tone in the paralysed side is reduced as well.

Other findings are as follows:

- Sensibility is diminished in 12 % of the patients, though this observation is of relative value only as the communication disturbance of the patients make exploration difficult.
- Lumbar puncture is often hemorrhagic.
- Mobility is affected in more than two thirds of the patients though they can move about at home or over smooth surfaces with crutches and orthoses.
- Behavior is normal in two thirds of the patients. Depression is more often present than irritability. One third of the cases suffer memory losses.
- Speech disturbances are present to some extent in more than 50 % of the patients. The most serious cases of sensory aphasia result in total loss of communication, which occurred in 10 % of our patients. General motor aphasias predominated over the sensory ones, although both components were commonly mixed. Difficulties with articulation of words appeared in 40 % of the patients.
- Urinary incontinence occurred in 16 % of the patients, fecal incontinence was rare.
- Exudate was present in the ocular fundus in 15 % of the cases. Incidence of embolism, infarcts or hemorrhage was rare.
- Nystagmus was very frequent. Miosis was more frequent than mydriasis, but neither of these pupillary conditions was very frequent.

- The cranial nerve most frequently affected was the facial nerve, followed by the external oculomotor nerve and the glossopharyngeal one. These disturbances affected sight, speech and deglutition secondarily.
- The ophthalmologic disturbances were influenced by the patient's age. Incidence of cataracts was similar to that of healthy individuals.

7. Interval between the ACVA and rehabilitation treatment (Table 8)

Generally, our patients began rehabilitation treatment within two weeks after the ACVA occurred, in some cases the onset of treatment was later, however.

There is no doubt nowadays about the direct relationship between early treatment and its effectiveness. Hemiplegia treatment should never start later than after the first week, except for those cases where the general condition of the patient prevents it. The patient should be considered fit for rehabilitation onset within a few days after the stroke occurs.

Table 8: *Interval between stroke and onset of rehabilitation*

1 week	28 %
2 weeks	45 %
3 weeks	22 %
4 weeks	5 %

8. Rehabilitation treatment

Generally, all our patients were treated with kinesitherapy and occupational therapy. Other treatment was provided as necessary, such as speech and mobility assistance.

8.1 Kinesitherapy (Table 9)

The most frequently employed techniques were proprioceptive neuromuscular stimulation, especially Kabat's (8) and Brunnström's (9).

Table 9: *Kinesitherapy*

Passive initial exercise	61 %
Kabat	65 %
Walking restoration	60 %
Equilibrium and coordination	82 %
Respiratory kinesitherapy	18 %
Postural correction	39 %

8.2 Occupational Therapy

During the treatment, we focused mainly on achieving independence by means of training patients on manual activities or improvement of the functional ability of the lower limbs.

8.3 Orthopedic aids

The most frequent aids provided were British crutches, followed by wheelchairs for those who could not walk. In some cases, corrective ferules for the anomalous position of the hand were used. We often had to apply a drop foot device for the peroneal paralysis so as to attain a more stable and suitable walk.

8.4 Logopedic treatment was provided in case of aphasia.

9. Length of rehabilitation treatment

It was our premise to rehabilitate all those cases that we regarded as suitable for at least 60 days. If there was no improvement, we stopped earlier. As long as improvement was observed in the patient, the treatment was continued. Later on, we provided only occasional treatment so as to maintain previously achieved levels.

10. Assessment of the results

10.1 Motor level

300 patients were reviewed 3 years post-stroke, or even later. We evaluated motor disturbances applying Brünnström's scale.

10.2 Independence level in ADL

We used Donaldson's scale (10), modified and enlarged by Alcazar et al. (2), for the assessment. It contains other important social, economic, and work aspects. Assessment of dependence or independence gave the results shown in Table 10.

Table 10: *Independence in activities of daily living (ADL)*

Affected more than 75 %	56 %
Affected between 50–75 %	19 %
Affected between 25–50 %	11 %
Affected less than 25 %	14 %

10.3 Speech disturbances/independence

These parameters have already been studied by Hymamm (11) and Isaacs (12). There does not appear to be any relationship between speech disturbances and the patients independence level and behavior.

10.4 Work history post stroke

Due to the advanced age of our stroke patients, work reintegration was very rare. Furthermore, most of those who had still been in the labor force were granted permanent work incapacity status. Only housewives have generally kept on working since they had no alternative.

10.5 Age/Independence (Table 11)

Although the prognosis is not absolutely conclusive if we only consider age, higher mortality and illness are noticeable when people grow older.

Table 11: *Independence/age*

	Independent	*Partially Independent*	*Partially Dependent*	*Dependent*
91	0	0	0	1
80–89	0	3	0	3
70–79	60	32	27	29
60–69	20	27	10	9
50–59	9	15	1	3
40–49	0	3	0	3
31	4	1	1	0
26	0	1	0	0

11. Further developments

The onset of different impairments after the ACVA has a negative impact on the patients' life. Urinary infectious complications are common. But we must not forget the incidence of cardiovascular and digestive problems.

It is striking that decubitus ulcers have practically disappeared. At least this is an obvious medical break-through, once hygiene and postural treatment have been implemented.

The frequency of biliary disturbance is also noticeable, but it is difficult to interpret its relationship with ACVA.

12. Conclusions

- Studying the history it becomes evident that cardiac and diabetic patients are often suffering strokes. Adequate treatment and follow-up of these patients from a medical point of view, as well as better information and education of the patient about his illness and ways to improve would be important preventive approaches.
- Neurological damage and arthrosis worsen the prognosis of rehabilitation gains.
- A history of diabetes increases the risk of infections post ACVA, which are the main cause of death in these patients.
- Upper limb involvement makes treatment more difficult than lower limb involvement. Moreover, lower extremity orthoses assisting the patient to walk are more efficient than orthoses for hand functions.
- Patients with right-sided hemiplegia recovered better than those afflicted on the left side, a finding we cannot explain.
- We believe it necessary to contrast and evaluate the CAT results in a large number of patients as to the localization and etiology of these patients' vascular focus.
- Spasticity disappears in most patients under treatment, while hypertonia often persists and hyperreflexia is noticeable in almost 50 % of the cases.
- Late sensory disturbances are less serious and frequent than motor ones.
- Total independence is accomplished in 14 % of the patients admitted to the hospital. In order to reach that, patients must at least have motor stage 5 in the right upper limb, and 4 in the left one according to Brünnström. This is due to the greater use and functional efficiency of the right hand. 25 % of the patients are able to manage by themselves at home.
- The results obtained are alike for ischemic and hemorrhagic icti, even though the former have a higher incidence.
- Age is not important as far as the rehabilitation treatment results go, although occurrence of diseases and mortality do increase with age.
- Aphasia worsens the prognosis and prolongs the rehabilitation treatment, above all in the sensory aphasias.
- Facial paralysis persists with high frequency even after treatment.
- Measures must be taken to prevent infections in the patients, above all urinary and respiratory infections since they are the most frequent causes of death. As mentioned before, this requires better and more intense medical surveillance of patients affected by a residual ictus.

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Stroke: Influence of psychopathological conditions on rehabilitation and coping with daily living

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In the following, some results are presented describing the influence of psychopathological conditions on rehabilitation and coping with daily living. They refer to the same group of patients which had been rehabilitated for nine weeks on average in two rehabilitation centers and had been tested at home in the framework of a one year-up observation. (See above, von Ungern et al.)

These patients are younger than a similar group (N = 770), observed in the region of Kassel, who received no rehabilitation. Nearly 50 % are below age 70, 7 % are older than 80. The same number of women and men were treated.

In order to determine the state of health of the patients before the stroke, we investigated about 20 different physical and social activities, 6 of them serving as examples here. They may be considered to represent the level of activities of the whole population older than 60 years in the Federal Republic of Germany, differing less than 5 %.

Before the stroke, 50 % of the patients had not engaged in any handicraft, 4 out of 10 had not done any gardening, every fifth (20 %) person neither listened to the radio nor read any newspaper (10 %), 10 % of the patients had not had any visitors nor gone for walks outdoors.

Two thirds of the patients had had the cerebrovascular accident in the year before admission to the rehabilitation center; 20 % had had a repeated insult; 27 % suffered from different forms of aphasic impairments. The index pertaining to the "Hessische Pflegesatzgruppen" lists four categories of patients in need of help and nursing care: no help, little help, intermediate help, and much help. More than half of the patients in our study needed much help by other persons. Every fifth was impaired but needed no special help. During the rehabilitatiion measure, only 1 of 250 patients got worse, and on discharge only one third was classified to need intermediate or much help.

Those patients whose stroke had occurred not more than 6 months ago recovered significantly better than those whose stroke had occurred longer ago. Typical organic psychosyndromes were not particularly noticeable during the time of treatment, whereas psychological symptoms could be observed in various degrees. None of the patients had lost consciousness. Loss of memory or comprehension was observed in only one fourth of the patients. Every tenth patient showed an impaired sense of orientation, and 15 % suffered from impaired sense of time. There is no statistical evidence (tested with chi-square) that these psychological symptoms were related to any specific class of age, although the group of patients aged 75–79, and the men in general, showed more psychological symptoms.

On discharge, 5 % had disturbed time orientation, every fifth patient had impairments. Statistical testing of the changes and continued presence of psychological symptoms, and the changes of help and care needs during rehabilitation and at home according to the categories of "Hessische Pflegesatzgruppen" showed no correlation.

Changes in the need for help and nursing care varied. No or little help was needed by 39 % on admission, 69 % at discharge, and by 55 % one year later at home. Intermediate help and care was required by 39 % of the patients, 27 % at discharge and 32 % at home, because they could not eat alone or had difficulties with control of bladder and bowel. The number of patients who needed much help and care because they were bedridden or had no control of bowel and bladder, increased from 5 % to 13 %. Statistical testing showed no correlation to age, between groups of patients younger or older than 70 years, and did not correlate to sex, side of paralysis, or presence of aphasic symptoms or not.

Rehabilitation had positive results. Self-evaluations regarding life situation and living with the stroke revealed the changes that had occurred between admission, discharge and follow-up observation at home. At discharge, 12 % considered the stroke a heavy burden. One year later, having had to cope with daily living, this number has increased to 23 %; in less than 50 % of the patients, the answers given did not change.

It is of high statistical significance that patients with loss of comprehension and attentiveness neither read newspapers nor left home for walks outdoors. Aphasic symptoms also affected the frequency of reading newspapers, while watching television was less frequent with patients who had suffered loss of short-time memory.

The one year follow-up observation showed an increase of psychological symptoms. 22 % of patients suffered from loss of and difficulty with comprehension, every tenth had problems with sense of time, and 20 % with orientation of the self and location. 3 of 4 had impaired memory. These symptoms did not correlate to the amount of help and care needed at home after discharge.

The personal and social network showed the following: men were supported in daily living by their spouse, women got help from their children. Shopping is done by other persons in 71 % of the patients. Every fifth patient had private help at home, 5 % received nursing care and 8 % social help. 10 % lived in a nursing home.

When attentiveness and comprehension was diminished, patients read no newspaper, and they did not listen to the radio if they suffered from loss of short-time memory. 24 % of the patients did not read any newspaper at all after the stroke, compared with 10 % before the stroke. Finally, the patients with loss of sense of time had fewer visitors at home and rarely went for a walk (high significance).

The impact of psychopathological conditions has to be seen in connection with physical and social activities for subgroups, but the stroke increased inactivity: One third stayed at home and did not walk outdoors, only every tenth worked in the garden, and only every fifth engaged in handicraft. Having visitors and listening to the radio remained the same, but reading newspapers decreased to 24 % (10 % before). In general the patients got private help and care after discharge, but further support and outpatient treatment by trained staff is indicated in case of occurrence of psychopathological symptoms and physical disabilities.

Enhancing postural stability in hemiplegics using externally applied forces

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(United Kingdom)

1. Introduction

Significant medical resources and funds are taken up in the rehabilitation of patients having walking problems. These problems may exist either because of a specific neurological disorder or as a consequence of trauma. Hemiplegia is by far the most significant disorder which leads to the need for intensive rehabilitation techniques, and recent statistics (1) have highlighted the tremendous costs involved in the treatment of hemiplegics: In the United Kingdom 5 % of National Health Service resources are used up in their rehabilitation, with associated bed occupancies of 13 % in general medical wards and 25 % in geriatric wards.

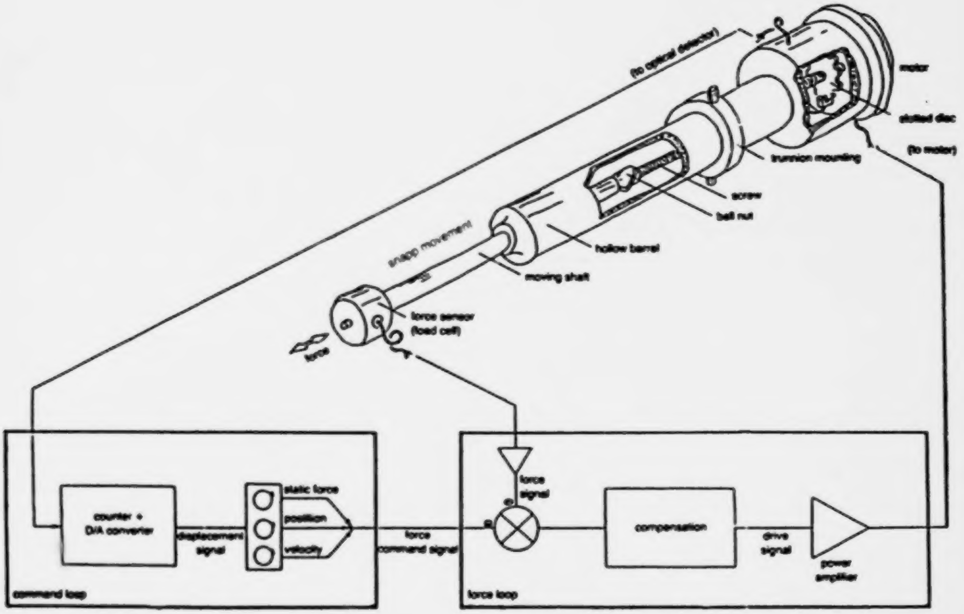
Physiotherapy departments are heavily involved in the process of rehabilitation, and again stroke patients are a major proportion of their work load. Although there is a continuing development of existing appliances, such as crutches and walking frames, these seem to have a fundamental disadvantage in that they create an unnatural posture and gait, largely because the support forces are applied via the arms, and it is often necessary to strengthen the upper limbs prior to the actual process of walking rehabilitation.

The work described here is the first stage in a research programme aimed at a radically new form of therapy for walking rehabilitation, the essence of which is to provide stability by the use of carefully controlled forces applied externally at or around the patient's centre of gravity. The mechanism which applies these stabilising forces will be under electronic control, and the patient will be able to exercise in a normal erect posture and with bidepal gait. The electronic control will enable the level of external stabilisation to be progressively withdrawn as the therapy proceeds, thereby encouraging the patient to re-develop stability on his own.

The paper describes a pilot study carried out to prove the technological and clinical concepts applied to stability in posture only; this has formed the basis for extending the research to the investigation of equipment which will enhance the patient's stability during ambulation. A brief description of the engineering aspects of the experimental apparatus is included, but the emphasis is upon the methods developed for collecting and processing data collected to quantify postural stability, and upon the results of clinical trials carried out with able-bodied and hemiplegic subjects.

2. The experimental apparatus

The ability to provide carefully controlled stabilising forces in response to the patient's movements is central to the whole concept. This has been achieved by means of electrically-driven actuators, a schematic representation of which is given in Figure 1. The electric motor turns a lead screw, and a high efficiency nut using ball bearings runs up and down the screw. A shaft is connected to this screw, and thereby rotary motion is converted into linear movement. The electronic control scheme, also shown in Figure 1, has two distinct actions. The first involves the addition of a force transducer to measure the net force applied by the actuator; this measurement is compared with a force command signal, and the error is amplified and used to drive the electric motor via a power amplifier. If the force command is zero, then it is possible to move the shaft of the actuator in and out with very small restraining forces – the feedback action causes the motor to drive so as to try and maintain zero force. The second action is to create force commands in a highly controllable manner depending upon the movements of the patient attached to the end of the actuator. These movements are measured by a counting-type transducer built into the actuator itself, which produces a signal proportional to the displacement from the central position, and by applying this signal as a force command creates a spring-like characteristic; varying the gain of the position feedback enables the rate of this spring to be electronically varied. A similar process using the actuator velocity gives a controlled damper-like characteristic. A third option is to apply a constant command signal, and this causes a constant force to be applied independently of the actuator's movement. It is of course possible to apply various combinations of all three types of force, as may be appropriate for stabilisation of the patient.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counter +
D/A converter
displacement
signal
static force
position
velocity
force
command signal
command loop
force
signal
compensation
drive
signal
power
amplifier
force loop

Figure 1: *The actuator and its control scheme*

The actuators were designed to have a stroke of 300 mm, a maximum speed of 300 mm/s, can produce a maximum force of 100 N. They are mounted in a gimbal arrangement in frameworks as shown in Figure 2, such that horizontal forces can be applied to a harness fitted to the patient. This harness was specially designed to provide a firm coupling between the actuators and the patient, and also to give an easily adjustable and comfortable fit for a range of patients. Two actuators are used in order to apply forces in the antero-posterior and medio-lateral directions. Figure 3 shows the way in which they are arranged. It also illustrates the other components of the complete system. The patient stands on a force measuring plate; the signals from this and the displacement and force signals from the actuators are monitored by a microcomputer. Signals from the computer to the actuators' electronic controller mean that the experimental investigation is directed from the computer's keyboard.

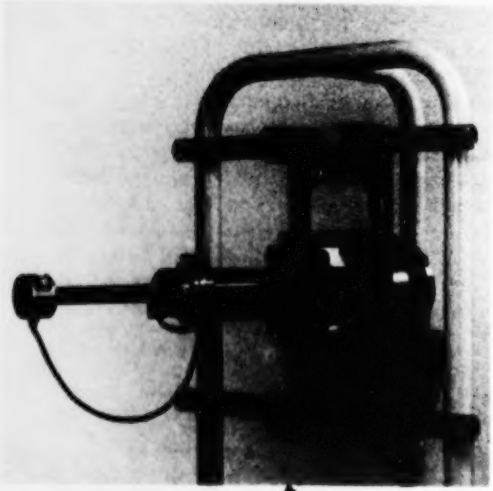
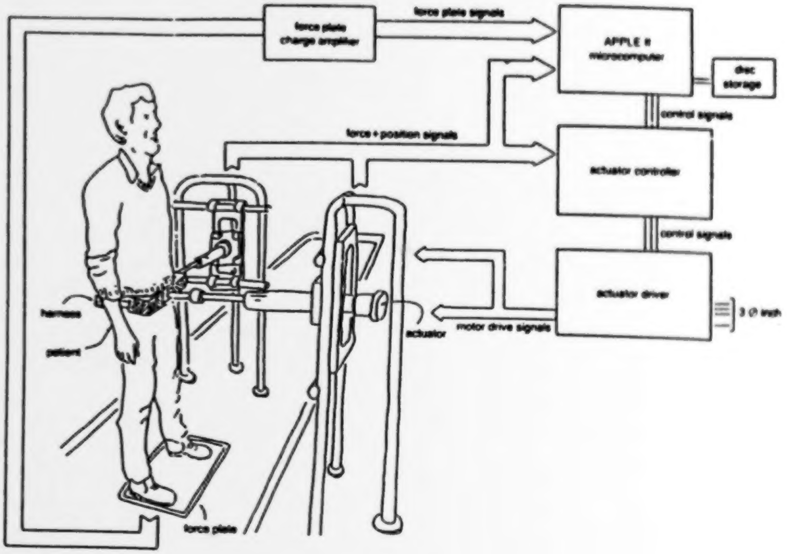


Figure 2: *The actuator in its framework*


force plate
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APPLE II
microcomputer
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actuator controller
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actuator driver
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motor drive signals
actuator
harness
patient
force plate

Figure 3: *The experimental arrangement*

3. The computer system

The microcomputer, an APPLE IIe, performs an number of functions: overall supervision of the test procedure (including provision of force commands for the actuator controllers), collection and storage of the test data, and subsequent processing and presentation of the results.

3.1 Supervisory function

A particular test to assess a patient's postural stability consists of a pre-determined period during which the various measurements are recorded. Initiating the recording process, identifying the test run and storing the data are all carried out by the computer. Two different types of test are possible. In the first, the patient simply stands upright; the patient's movements with and without the external stabilising forces activated can be compared. Alternatively it is possible to create a sequence of force commands on the computer; during the trial the actuators apply this sequence of forces to the patient, and his response to the disturbances helps to assess stability. Typical force command sequences may be purely sinusoidal or combinations of falling and rising ramps and steps. Sequences of force command can be saved on floppy disc and retrieved for use in many different patient trials, which ensures that for each trial the same forces and timings are maintained. Such a technique generates very consistent test conditions and ensures that results from using the same force profile with different patients (or with different levels of external stabilisation) may be validly compared.

3.2 Data collection and storage

The computer samples 8 channels of information: two actuator forces, two actuator displacements, and four vertical forces from the plate. The actuator force signals indicate the level of stabilising action being applied, the actuator displacement signals give the movement of the patient's centre of gravity and the force plate signals enable the position of the patient's centre of pressure to be determined. All these signals are sampled at 32Hz (a lower sample rate has been found to be less satisfactory), and in the course of a trial of 60 seconds duration some 15 000 data samples are stored temporarily in the computer's memory. At the end of the trial the four force plate signals are processed to give the co-ordinates of the centre of pressure, and this and the other information are saved in a suitably named file on floppy disc.

3.3 Presentation of results

A number of different display techniques for the results have been developed. These may be sub-divided into two categories – straightforward time histories or overall profiles of the trial.

For the time histories, the results are presented in Cartesian form with time as the major axis. Each display has separate graphs for the M-L and A-P directions, and combinations of the following signals may be plotted: patient centre of pressure at the force plate, actuator movement, force command and actual force. Figure 4 shows a typical set of results displayed in this form. The displays are useful in that they give a good visual indication of how a patient may have performed during a trial. Although they are non-mathematical, they may be used to compare visually the performance of different patients, or the same patient over a period of time. In addition, trends occurring over the 60 second period may be noted. For example, a patient may become noticeably less stable toward the end of a trial, perhaps owing to fatigue.

Overall profiles of the results of the trial can be obtained by processing the data. One of the major techniques used is to present the Cartesian co-ordinates of the patient's centre of pressure in the form of a force plate map. This is a graphical representation of a plan view of the force plate, with the position of the centre of pressure superimposed. The magnitude of the patient's sway over the trial period may be quantified by the area of an enclosing rectangle – a typical force plate map is shown in Figure 5. Another method is to use histograms. Both the centre of pressure co-ordinates and the actuator displacements (i. e. the movements of the patient's hips) can be plotted as statistical distributions, the vertical

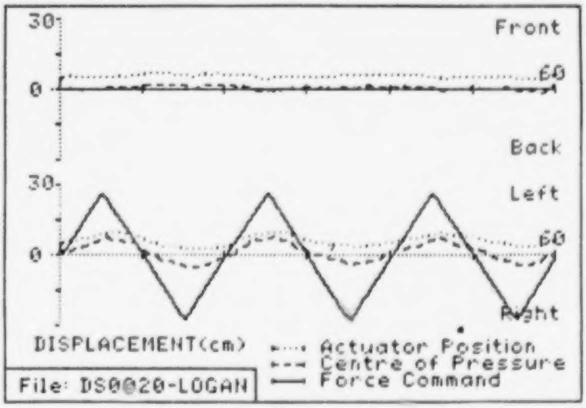

Figure 4: *Example of time history presentation of results*

axis being the percentage of time spent at a particular displacement; means and standard deviations can be derived to quantify these distributions. Figure 6 shows typical profiles for the centre of pressure position for an able-bodied and a hemiplegic subject. These not only demonstrate the reduced sway of the able-bodied subject, but also highlight the typical hemiplegic 'lean' away from the upright position. The coordinates which give the A–P and M–L displacements can alternatively be used to derive a single figure for the distance away from a reference point – a similar statistical presentation can be used. All these profile type of presentations are valuable in that they give a more easily assimilated indication of a patient's performance during a trial. The area of the enclosing rectangle of movements on the force plate map has been adopted as a primary indicator of stability because it provides a single parameter for comparison between patients or between different levels of external stabilisation.

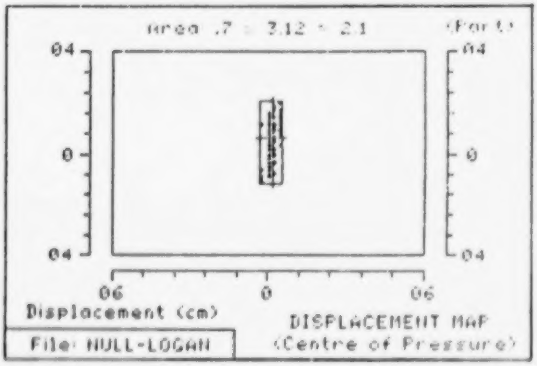

Figure 5: *Example of force plate map*

4. Clinical trials

Limited trials have been carried out with both able-bodied and hemiplegic subjects using the system which has been described. Most of the trials with able-bodied subjects were used to commission the equipment, validate the instrumentation and establish a sensible methodology, but the results also provide a base line for comparison with those from the hemiplegic subjects. This section details the methods used in these trials and discusses the preliminary findings.

4.1 Methodology

The procedure adopted for each patient was to fit the harness to the individual and obtain a 'null' file, i. e. a 60 second trial with no force commands. This gave a measure of the inherent balance of the patient without any supportive forces being applied. (The actuator controllers were set to provide no support but just to follow the movement of the patient). This 'null' procedure was repeated halfway through the session and once again at the end; this served as a basis for comparison for all the data. Following the 'null' procedure, the patient was given support by means of a simulated spring (Ss), damper (Ds) and/or both together (SDs) with, in each case, a high value followed by a medium and then a low value.

Further to this basic procedure, the patients were also subjected to a series of force command profiles from each actuator as described in the computer system section. These enabled the balance and stability of the patient to be quantified in engineering terms and to provide some basic information regarding the behaviour of patients with impaired balance. All of these procedures were repeated with subjects with normal balance for comparison purposes. This scheme of force profiles was repeated at least twice for each patient and the data printed out for analysis.

4.2 Patients

Suitable hemiplegic subjects were selected for the research programme on the basis of being in the latter stages of recovery and also being unaffected by any other conditions likely to affect their balance and so confuse the results. All of the patients had inherent stability without external support whilst standing, although they all needed some assistance with their walking. The trials have so far concentrated on four patients, each of whom have attended for two sessions. Patient details are given in Table 1. The assessment rating was given by a physiotherapist and is on an arbitrary scale fom 0 to 5.

Table 1: *Patient details*

Patient	*Age*	*Sex*	*R/L*	*Time post stroke*	*Rating*
CMcL	62	M	L	6 weeks	3
NB	64	F	L	8 months	2/3
JJ	83	M	L	6 months	1/2
VL	50	M	R	2 months	3

Control volunteers were included to obtain an estimate of the kind of results achieved by stable people. These subjects were all in the age range 20–30, which is not ideal as it would have been better to have people of the same age as the patients. Nevertheless the results give a quantification for what would be considered to be a high level of postural stability.

4.3 Results

Despite the small number of patients a large number of computer files were created, and these were examined for each patient in each combination of support type. It became clear from the results that for all the patients some form of external support was advantageous. In all cases the support produced a more stable stance and a more even balance between the feet.

To illustrate the effect of the stabilisation of the patients by the use of spring support, damping and both together, the data from patient NB is used. Only two displays of the data are presented out of all the possible combinations of displays available. The displays chosen were the displacement map of the centre of pressure on the force plate and the displacement profile of the actuators. These present a picture of the displacements of the patient both at the level of the hips and at their feet. On the centre of pressure map the points representing the data form an irregular pattern. The enclosing rectangle is not shown, but its area is given at the top.

Figure 7 shows results for patient NB with no supportive forces applied, and indicates an area of 3.71 cm^2 for centre of pressure and an narrow displacement profile but grossly offset to the hemiplegic side. The picture is very different in Figure 8, which shows NB with a Ss of 2000N/m. There is a reduced area of centre of pressure (2.3 cm^2) and a narrow displacement profile which is centred. This indicates that the patient is being held upright in a more normal erect posture than with the traditional lean to the affected side. Figure 9 shows the situation with a Ds of 500N/ms^{-1}. Here the area of the centre of pressure is slightly less than with Ss at 1.9 cm^2, but the displacement profile is narrower but offset to the affected side. This suggests that a strong Ss will provide an erect but uncertain posture which the patient feels to be unnatural. A relatively large area of centre of pressure is produced by the patient almost fighting the system to return to their 'natural' position. With a Ds the patient is allowed to return to their happy 'natural' offset position and allows them to remain there in a steady state. A compromise situation is shown by the results of Figure 10 using a Ss of 500N/m and a Ds of 500N/ms^{-1}. This produces the smallest area of centre of pressure at 1.1cm^2

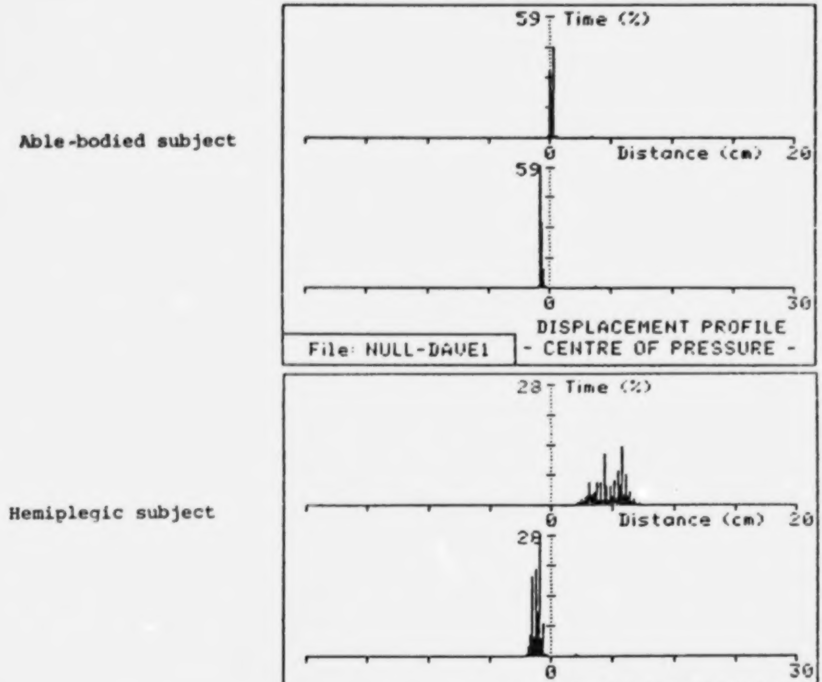

Figure 6: *Example of displacement profiles*

and a narrow displacement profile, which indicates a nearly erect posture. The situation presented using patient NB as an example is repeated for the other patients although there are differences in detail.

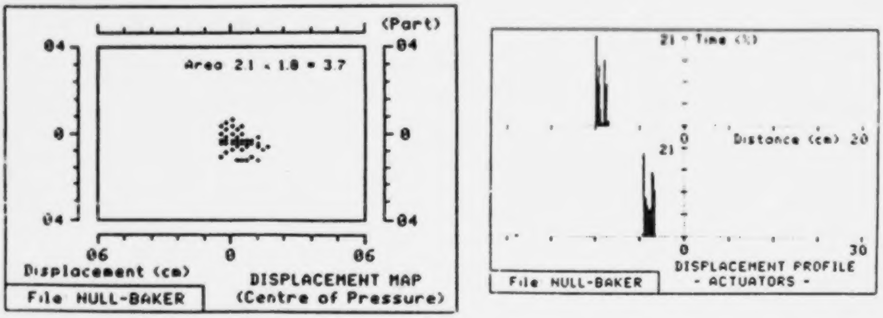

Figure 7: *Results for patient NB with no stabilisation forces*

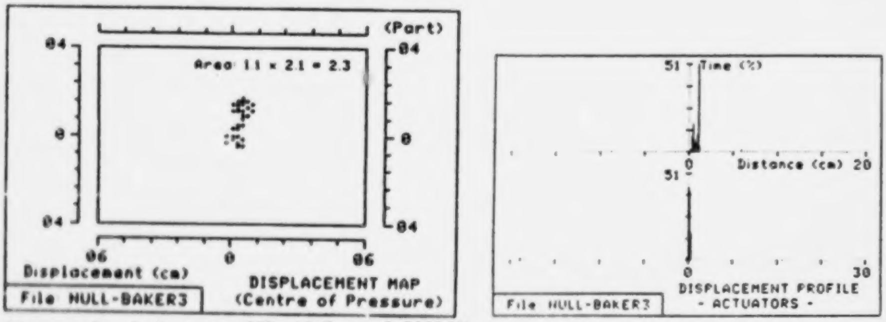

Figure 8: *Results for patient NB with Ss equals 2000 N/m*

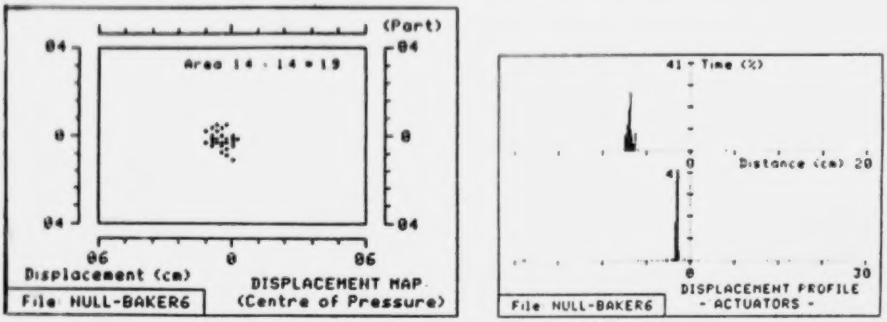

Figure 9: *Results for patient NB with Ds equals 500 N/ms^{-1}*

5. Conclusion

Although tests have only been carried out with a small number of patients, the results have established that it is technically feasible to provide carefully controlled stabilising forces, and that these do indeed enhance the postural stability of hemiplegic patients. It remains to assess patients regularly over the period of their recovery in order to identify any trends

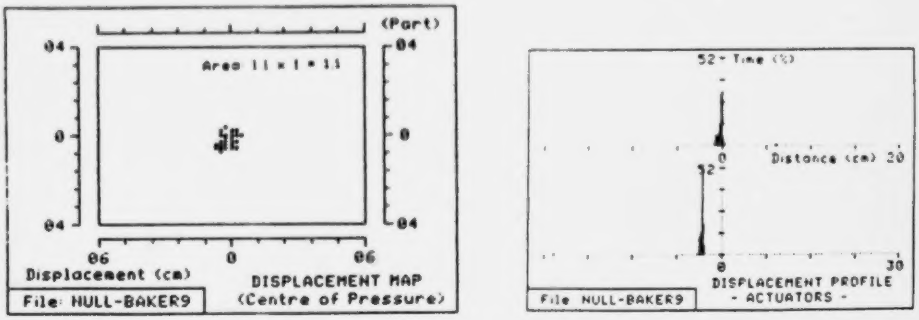

Figure 10: *Results for patient NB with Ss equals 500 N/m and Ds equals 500 N/ms^{-1}*

shown by the quantification of postural stability. Although the long term aims of the research are towards a system of therapy, it had not been expected that there would by any therapeutic benefit from enhancing postural stability alone. However, there were some indications that a series of force inputs applied to the patients by means of the actuators could be used for a limited form of therapy similar to the principles of 'rhythmic stabilisation' commonly used by physiotherapists at present. In addition to the understanding of how postural stability in hemiplegic patients may be enhanced, the research programme has also established a sound basis for extending the concepts to include walking.

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Group 4:

Free papers

Chair: Prof. Dr. E. Fricke, Sendenhorst, Fed. Rep. of Germany

Effectiveness of two modes of training to overcome deficits of concentration

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Present are some first results of a comprehensive clinical experimental study about the effectiveness of two forms of apparatus-supported training to overcome deficits of concentration. But first some preliminary remarks on the theoretical concepts and procedures of the training.

1. Theoretical remarks

Psychological "attention" involves a process of internal orientation and centralization of psychic events, or the probability of paying attention or focussing on specific objects, that depends on: the organization of the sense organs, sustained attitudes, present condition, and social norms. A distinction is often made between conscious, voluntary, and involuntary attention, referring to internal or external controlling and focussing aspects. "Concentration" means the voluntary, conscious focussing of attention to relevant internal or external stimuli. In the field of neuropsychology, attention is a "mental activity variable", a hypothetical construct that concerns the efficiency of mental processes (Lezak, 1983).

Attentional processes are involved in any processing of information, as for instance in receptive functions, memory, thinking, or expressive functions, and ensure that these cognitive variables refer to relevant aspects of the environment and/or the self in a given situation.

There is consensus, to some extent, about three components of attention (Wilson & Moffat, 1984):

(1) *Alertness/Arousal:* Refers to a fluctuating condition of the central nervous system, varying from sleep to wakefulness.

(2) *Selectivity/Selective Attention:* Refers to the focussing aspects of attention, to the process of conscious perception of specific stimuli and subliminal perception of unspecific ones.

(3) *Tonic Alertness/Effort/Concentration:* Refers to the conscious, sustained cognitive management of stimuli, a coordinating process of alertness and selectivity.

Shiffrin and Schneider (1977) describe two modes of information processing, one which depends on attention, called "controlled processing", and is needed for instance in learning a new task until the response can be made without conscious control, and one which is independent of attention, called "automatic processing", which occurs after such a complex process of learning. Automatic processing does not enhance the capacity of the information processing system. After brain injury many automatic skills have been impaired, and the patients seem to be dependent on a more controlled form of processing. Two forms of attentional deficits become apparent in this situation:

(1) *Focussed Attention Deficits (FAD)*, " . . . which occur, when an automatic response is replaced by a controlled response" (Wilson & Moffat, 1984).

(2) *Divided Attention Deficits (DAD)*, " . . . which occur, when controlled processing is in use and where the limitations of the system fail to accommodate all the information necessary for optimal task performance" (Wilson & Moffat, 1984).

In neuropsychology, the question of cerebral localization is always asked. Attentive behavior is seen to have its foundations " . . . in an extremely complex relationship between reticular system, thalamical and different cortical structures" (McGhie, 1978). Highly simplified brainstem parts of the reticular system seem to be involved in activating and sustaining aspects of attention, and thalamical parts in the focussing ones. Some studies seem to show that right-hemispheric structures are relevant for sustaining, long-time processes, and left-hemispheric structures for short-time attentional processes.

2. Background

Training of concentration becomes necessary since " . . . an initial attentive stage in the processing of information is basic to all tasks and . . . a dysfunction here . . . influences all later stages in the behavioral sequence" (McGhie, 1978).

About 70 % of our patients in a neurological rehabilitation center show deficits of attention that disturb the physical, psychological, social, and vocational process of rehabilitation or make it impossible. Clinically, these deficits of attention manifest themselves as distractability, as slowing-down the process of decision-making and information processing, a heavy reliance on feedback from a given task, a tendency for inappropriate behaviours when behavioural alternatives arise, and so on.

Most patients in our clinic arrive with brain disorders falling mainly into categories of: head traumata, vascular disorders, neoplasms, infectious processes, toxic conditions.

About 15 % of all our patients undergo an apparatus-supported training for deficits of concentration. Such an intervention is always part of an integrated treatment approach with psychological, physical, occupational and vocational aspects tailored to the personality in a specific life situation and motivational state.

3. Methodology and findings

The apparatus-supported practical exercises with patients are done by trained assistants under instruction and supervision by the responsible neuropsychologist. The training procedures have been developed in the early 80s, patterned after studies of Kallinger (1975) and Sturm et al. (1983); they have been modified according to our specific experience, and designed for our clients.

The indication for such a treatment can only be determined by the clinical neuropsychologist after an accurate assessment in which the nature of the deficits is identified and a specific procedure for training selected. The apparatus-supported training relates mainly to the above mentioned attentional component of tonic alertness.

The apparatus-supported training of concentration is carried out with the "Wiener Determinationsgerät" (WD), a device for investigating the capacity for and certainty of reaction to quickly changing visual and auditory stimulation, and on the "Wiener Testsystem" (WTS), a microprocessor-controlled apparatus which presents specific attentional tasks to the subjects on a monitor. On the WD, programmed according to Sturm et al. (1983), all possibilities were explored to increase the requirements of the training continuously from session to session. On the WTS, the programs "Pauly Test", "Daueraufmerksamkeit", and "Signal Detection" were used. Just as with the WD, all possibilities to increase the requirements were applied.

45 patients of our clinic participated in the study. After extensive diagnostic pretesting, the subjects were assigned to one of two experimental groups or one control group. The experimental groups were trained for 4 weeks, half an hour daily on the WD and WTS using the above mentioned programs. All experimental subjects had 20 training sessions. The control group participated – like the experimental groups – in the normal clinical interventions, but received no specific training of concentration. Control and experimental groups were retested with the same set of tests comprised of 107 intellectual, attentional and mnemonic variables four weeks later.

The training procedures for the two experimental groups were different. Training for one group (T1) was continuously made more demanding, independently of performance and progress. Training demands for the other group (T 2) were modified depending on these variables. The design of the study, schematically drawn, is shown in Table 1.

Table 1: *Study design (schematical)*

Pretesting		Posttesting
T1	Xs	T1
T2	X1	T2
Controls	—	Controls

T1: Experimental group with standardized augmentation of demands

T2: Experimental group with augmentation dependent on baseline performance and progress in training

Xs: Standardized training

X1: Baseline and progress-dependent training.

The sample is described as follows (see Tables 2–7): The mean age is 32; 8/5th were males; nearly 70 % had finished 9 years of school; about 40 % had traumatic or vascular impairments; about 30 % had right-, left-, and diffuse hemispheric lesions; the time elapsed after brain lesion occurred ranged from less than 6 months to more than 3 years, with a mean of less than 6 months.

Table 2: *Age*

	N	%
-20 years	2	2.4
20–30 years	24	53.3
30–40 years	7	15.5
40–50 years	9	20.0
50–70 years	3	6.7

Table 3: *Sex*

	N	%
Men	40	88.8
Women	5	11.5

Table 4: *Education*

	N	%
9 years of school	31	68.8
10 years of school	9	20.0
13 years of school	5	11.2

Table 5: *Localization*

	N	%
Right hemisphere	14	31.1
Left hemisphere	14	31.1
Diffuse	17	37.7

Table 6: *Diagnoses*

	N	%
Head trauma	21	46.6
Vascular disorders	18	40.0
Toxic conditions	3	6.7
Epilepsy	1	2.2
Neoplasms	1	2.2
Infectious processes	1	2.2

Table 7: *Time after onset*

	N	%
– 1/2 year	19	42.2
1/2–1 year	11	24.4
1–2 years	10	22.2
2–3 years	2	4.4
more than 3 years	3	6.7

We have to accept that the distribution of our sample and of the three groups for the independent variables is not normal (see Tables 8,9). A comparison of the 3 groups shows quite good correspondence, particularly if you consider that sampling is influenced by normal, every day life of the clinic.

Table 8: *X2 – Test of distribution*

	X2	Significance 0.001
Age	34.40	s
Sex	27.20	s
Education	26.00	s
Diagnoses	58.59	s
Localization	0.38	–
Time after impairment	21.00	s

Table 9: *X2 – Test of distribution of the 3 subsamples (s Significance = 0.05)*

	T1	T2	Controls
Age	s	s	s
Sex	s	s	s
Education	s	–	s
Diagnoses	s	s	s
Localization	–	–	–
Time after Impairment	–	–	s
	n 15	n 15	n 15

Our first unsystematic experiences showed that, generally, there was good acceptance of the training. Only about 15 % experimental drop-outs occurred, the distribution of which indicates that the baseline and progress-dependent procedure was better accepted.

The control group showed significant progress in 47 % of the 107 variables. The experimental group T 2 with the baseline and progress-dependent training showed progress in 56 %, and the experimental group T 1 with the standardized training showed progress in 58,8 %, sometimes at the 1 % significance level. The comparison of each of the experimental groups with the control group shows that the effects of training cannot only be caused by spontaneous recovery, test repetition, or direct training of the tested functions (see Tables 10, 11). The T 1 group, compared with the control group, shows significant progress in the intellectual function of closure 2 (LPS 10), and in 3 psychomotor functions, closely resembling the training procedures. Comparison of the T 2 and the control group shows a significant benefit for the experimental group in intellectual functions such as word fluency (LPS 5) and closure 2 (LPS 10), in memory functions, e. g. verbal immediate memory (AVLT standard), recognition in verbal memory (AVLT and IST-70 recognition), and in verbal memory with free recall (SKT VIII).

Table 10: *T1 versus controls* (only significant results)

	/ U /
LPS 10	59.5
Sustained attention, wrong reactions	65.0
Wiener R, sound/light EZ	53.0
WD, training session, wrong reactions	47.0

Table 11: *T2 versus controls* (only significant results)

	/ U /
LPS 5	59.0
LPS10	65.0
SKT VIII	54.5
AVLT, standard, correct answers	62.5
AVLT, recognition, correct answers	60.0
IST-70, recognition, correct answers	64.0

An important tendency is shown, which Sturm et al. (1983) have also reported. Progress in performance after training of concentration can be demonstrated not only for concentrational or psychomotor functions but also for intellectual and memory functions.

In comparing the T 1 group with the control group, as regards the U-test, we see 4 significant results. The corresponding comparison between T 2 and controls shows 6 significant variables. A direct comparison between T 1 and T 2 shows an advantage for the T 2 group only in the variable "reaction time to complex stimulation".

All in all, the results show a slight but clear advantage for the baseline and progress-dependent training in as far as the T 2 group showed clear gains in mnemonic functions, beyond the effects found in the T 1 group.

The study shows that a specific, apparatus-supported training of concentration will under certain circumstances be a good intervention approach also for intellectual and memory deficits. An unspecific or situational training – as done for instance in normal rehabilitation interventions – appears to be a good preparatory training before starting specific treatments. Specific training of concentration should be based on an extensive process of neuropsychological exploration that accurately identifies the nature of the attentional deficits, to precisely select the training procedures to be followed. In some cases, is may be beneficial if specific concentrational training is preceded by unspecific interventions.

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Psychosocial factors influencing return to work after coronary artery bypass surgery (CABS)

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1. Introduction

Improving the patient's quality of life by cardiac surgery is the main interest of surgeons and patients alike. To date, a decisive component of a positive quality of life for most of the people between the ages of 20 and 60 years is their capability to work and to maintain a job. Besides the importance of work for the individual, there is a strong socio-economic interest that patients who have undergone such an expensive procedure as cardiac surgery become productive members of society again. In Germany this interest has been incorporated by law into the aims of rehabilitation.

2. Purpose and objective

Comparing the percentages of CABS-patients who are vocationally reintegrated in the Federal Republic and the United States, we see a considerable difference. Taking the mean results of the investigations shown in Table 1, we see 46 % of the patients returning to work in Germany, as against 64 % in the United States. The difference of about 15 % can be explained by 3 factors: lower density of the social net, lower availability of disability benefits, and shorter preoperative waiting periods in the United States. Comparing the percentages of employed patients pre- and postoperatively, we see a marked decline postoperatively. This tendency exists in Germany just as in the United States; it is however more pronounced in Germany.

Table 1: *Comparison of return to work after CABS in the Fed. Rep. of Germany and in the United States (follow-up period 12 to 60 month).*

Author	*Working*	
(Fed. Rep. of Germany)	preoper. %	postoper. %
BORST (1981)	80	50
WALTER et al. (1983)	78	38
VETTER et al. (1985)	–	48
HACKER et al. (1985)	–	48

Author	*Working*	
(USA)	preoper. %	postoper. %
HAMMERMEISTER et al. (1979)	75	62
JOHNSON et al. (1982)	69	59
HELLER et al. (1982)	–	76
WENGER et al. (1985)	–	66
GUTMAN et al. (1985)	–	58

The time of follow-up in the studies mentioned was at least 12 months after the operation; this period of time is long enough for most patients to complete the process of occupational reintegration. Patients taking part in long-term job-retraining are the exception, only 6 % in Germany as reported by Vetter et al. (1985).

These results support the hypothesis that coronary artery bypass surgery is not the way to improve vocational rehabilitation as such. These somewhat disappointing findings have given rise to a number of research projects concentrating on the factors supporting or hindering a patient's return to work after surgery.

In general, the question of whether a patient will return to work after serious illness is much too complex for the answer to be predictable by medical parameters alone. The factors pertaining to disabled persons' return to work are given in Table 2. The 5 categories given refer to the individual; the socio-economic situation, marked by the availability of disability payments, the rate of joblessness, or the availability of part-time jobs, should be added.

Interviews of patients with CABS concerning reasons for not resuming work indicate that postoperative employment status is not solely determined by cardiologic findings. Only 30–40 % of the patients questioned said that heart problems had kept them from returning to work (Anderson et al., 1985; Jenkins et al., 1984). Hacker et al. (1985) reported that 39 % of prematurely retired patients were free of angina.

Table 2: *Factors found to be related to disabled persons' return to work* (from: Safilios-Rothschild, C., 1970, p. 233).

Demographic variables
e.g. age, education, pre-disability income
Sociopsychological variables
e.g. reaction or attitude to disability, attitudes of significant others towards disability
Vocational variables
e.g. pre-disability employment status, attitude towards work
Medical variables
e.g. degree or severity of disability, presence of secondary diseases
Psychological variables
e.g. motivation to work, adaptability to change, intelligence

3. Results and discussion

3.1 Nonmedical variables

Which nonmedical factors could be confirmed empirically to influence occupational rehabilitation of patients after coronary surgery? The majority of studies found the following 4 nonmedical factors to be prognostically relevant: age, level of education, physical demands of job, extent of preoperative unemployment.

(1) Age

From the results shown in Figure 1, Walter et al. (1983) concluded: „The older the patient at the time of operation, the higher the chance that he will retire postoperatively".

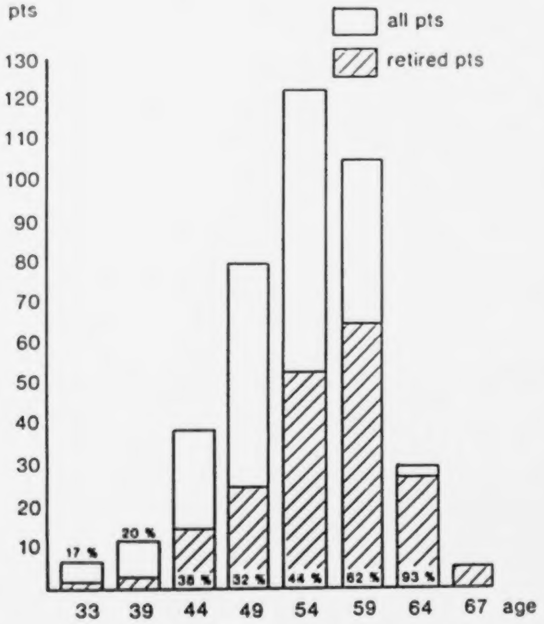

Figure 1: *Frequency of "premature" retirement of patients (pts) after CABS in various age groups (Walter et al., 1983).*

Subdivision of the sample into different age groups shows a continuous increase in the percentage of retired patients. In age group 45–49 years, 32 % of patients are retired; in the 55–59 age group, 62 % retired postoperatively. Interpreting these results – especially the last mentioned high percentage of retirement – we have to keep in mind that, in general, only 9 % of employees are working until the age of 65 in West-Germany. As a rule, gainful employment already stops at age 59 (Frankfurter Rundschau, 6. 11. 1984). Wenger et al. (1985) found in the USA that a critical point is reached at age 50: 80 % of patients under 50 years old went back to work, as against only 61 % of those over 50.

(2) Educational level

The prognostic effect of educational level is documented in the United States as well as in Germany. A higher level of education favours return to work, as shown in Table 3. Walter et al. (1983) report that of the working patients, 3 times as many had finished high school compared with postoperatively retired patients.

Table 3: *Return to work and educational level* (Wenger et al., 1985)

Educational level	*Return to work*
college degree	78 %
technical college	65 %
high school	62 %
elementary	40 %

(3) Physical demands of job

The type of occupation followed preoperatively is another influencing factor, and is mostly directly related to educational level. In general, the physical demands of a job decline with higher intellectual demands.

Rothlin et al. (1985) report the results given in Table 4. 65 % of patients not working postoperatively were blue-collar, 35 % white-collar workers. The relationship was reversed for the working patients. Concerning physical demands of jobs, Wenger et al. (1984) found that 58 % characterized their jobs postoperatively as having minimal or light activity; only 9 % reported hard physical work.

Table 4: *Return to work and preoperative occupational status*

	Not working	*Working*
Blue-collar	65 %	30 %
White-collar	35 %	70 %

In Germany, self-employed persons have the most favourable rate of vocational rehabilitation (Vetter et al., 1985; Benesch et al., 1979; Walter et al., 1983). As reported by Benesch et al., 78 % of the self-employed returned to their jobs, followed by office workers with 57 %, while only 21 % of blue-collar workers resume their work.

(4) Extent of preoperative unemployment (Figure 2)

Another important influencing factor, which could be confirmed most often empirically, is the extent of preoperative unemployment (David et al., 1979; Jambroes et al., 1985; Rothlin et al., 1985).

Resumption of work is directly related to the duration of preoperative disability. When it was relatively short with 4 months duration, the percentage of those resuming work was twice as high as of those who did not. If 18 months had elapsed between onset of illness or diagnosis and the operation, only every fifth patient returned to work.

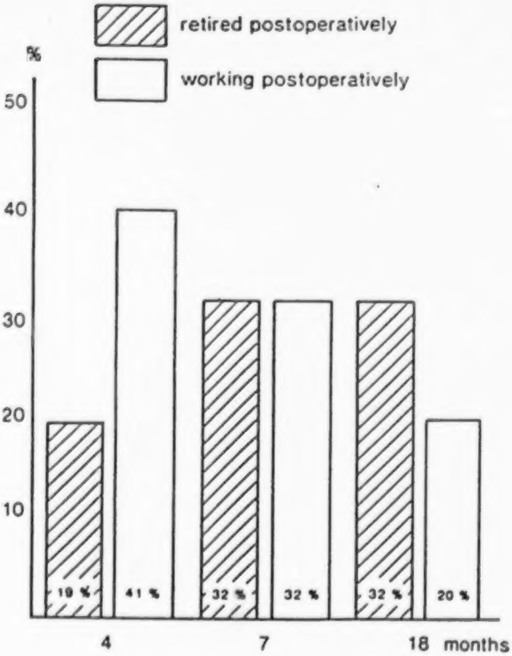

Figure 2: *Extent of preoperative unemployment (Walter et al., 1983).*

The differences between rates of vocationally rehabilitated patients in Germany and the United States mentioned initially may in part be directly attributable to the difference in preoperative nonworking periods. While 93 % of West German patients are unable to work for more than 2 months before having their surgery, this applies to only 25 % of the American patients (Walter et al., 1983).

3.2 Medical variables

The findings regarding predictive relevance of objective cardiac parameters are very diverse. Thus, Welsch et al. (1985) and Gutman et al. (1985) report that left ventricular function and the degree of revascularization affect occupational reintegration; other authors (Bentall et al., 1985; Nitter-Hauge et al., 1985; Bergman et al., 1985) found no correlation between employability and objective data of left ventricular function, left ventricular enddiastolic pressure, ejection fraction, completeness of revascularization, and number of open grafts. Variables based additionally or mainly on patients' subjective complaints, as for example the New York Heart Association Classification, or change in degree of angina postoperatively, seem to affect return or non-return to work most strongly. The study of Wenger et al. (1985), for example, shows the absence of chest pain to be the best predictor. The predictive value of completeness of myocardial revascularization, of myocardial contractility, and of the number of myocardial infarctions prior to surgery were much lower.

These findings lead to the conclusion that it is not so much hard objective facts marking severity of the disease and/or its prognosis, that determine occupational status postoperatively; rather, subjective experience and coping with the somatic condition on the part of the patient are important.

A follow-up study 3 to 5 years postoperatively (Speidel et al., 1981) showed a general tendency of cardiac surgery patients to exaggerate the importance of cardiac symptoms as true indicators of illness. Comparing objective parameters to the symptoms subjectively experienced by the patients, the subjective complaints usually seemed to indicate greater physical damage than could be diagnosed objectively. The tendency to exaggerate depended on patients' psychological condition; the discrepancy was larger with depressive and anxious patients than with emotionally stable ones.

3.3 Psychological variables

Variables which are typical for pre- und immediately postoperative ways of coping with the illness not only allow prediction of long-term psychological adjustment (Boll, 1986), they also bear on the prognosis of vocational rehabilitation. The results obtained by Kimball et al. (1973) above all indicate a negative influence of preoperative depressive mood. 6 months postoperatively, significantly more of those patients had returned to work who, preoperatively, had had only an average degree of anxiety and less depression, who had had adequate defense mechanisms, whose life adjustment had been good, and who had had realistic and concrete plans for the future.

Another psychological predictor is the patient's desire to work again after the operation (Lamendola & Pellegrini, 1979). 97 % of patients who did not want to work again actually did not resume work, while of those working each had had the desire to do so again.

Questioning the patients for reasons of their desire not to resume work after the operation we get very diverse answers. Availability of disability benefits plays an important role. If a patient receives as much money by retirement payments as he has earned by doing his job, this will favour his decision not to go back to work. Another reason which often could be found is the attitude of the patient that he has worked enough during his life, because he has worked a lot of overtime. Counting his overtime, he feels that he has worked as much as people who retire regularly (at the age of 65 in Germany). Rationalizations like this are used to justify the wish for being taken care of. Surgery legalizing regressive needs is often found with patients who felt overstrained and unsatisfied in their jobs, already for a long time prior to illness. Retiring prematurely, these patients get a high secondary gain of illness, consisting of care, and rest. Many patients are afraid not to be able to work as efficiently as before the operation. They fear financial restrictions and loss of prestige; they anticipate – often without concrete reasons – to have to do jobs with lower qualification and, therefore, decide not to resume work. A high rigidity of many coronary patients impedes those abilities which are necessary to adjust adequately to vocational changes and limitations (Brenner, 1984).

In one of our own studies (Boll et al., 1981), which besides coronary bypass patients included patients who had had open-heart surgery, we found that the preoperatively expressed desire to work again after surgery plus an optimistic attitude with concrete future plans correlated most closely with the criterion. The correlations were better than those of various medical predictors.

Tables 5, 6, and 7 show which of the psychological variables gathered preoperatively, immediately postoperatively, and just before hospital discharge correlate significantly with the criterion.

More preoperative depression, as measured by an interview rating as well as by a moodlist, a higher degree of anxiety and more passiveness as well as psychopathological disorders, strong feelings of stress caused by the waiting period and negative emotional changes caused by the heart disease were hindering factors. Vocational rehabilitation was favoured by dominant personality structure and higher activation, by more optimism and plans for the future, among them the desire to work after surgery. The significance of the emotional stress caused by the illness so far prior to operation indicates that occupational reintegration is not only put into question by inadequate coping with the actual trauma, i. e. the operation, but also by inadequate dealing with the chronic disease. The significant correlations with the variables obtained on the 7th–10th day postop. and just before discharge corroborate and complete the preoperative findings. On days 7–10 above all measures of depression could be identified as predictively valuable.

The finding that it is mainly variables characterizing the emotional state and the specific situation of a patient that favour or impede occupational reintegration, confirms the importance of coping processes. Permanent, basic psychological traits had no predictive value, with the exception of a dominant personality structure observed preoperatively. However, since the sample was relatively small – only 40 patients could be included – the findings probably cannot be generalized.

Table 5: *Significant correlations (a ≤ .05) between return to work and preoperative psychological variables*

Variable	*r*
Negative emotional change caused by disease	– .43
Optimism and plans for the future	.59
Desire to work after surgery	.56
Stress during the waiting period	– .34
Dominance	.34
Psychopathological disorders	– .36
Depression (rating)	– .26
Depression (moodlist)	– .34
Activation	.28
Passiveness	– .34

Table 6: *Significant correlations (a ≤ .05) between return to work and postoperative psychological variables (7th – 10th postop. day).*

Variable	*r*
Psychic and somatic complaints	– .36
Anxiety and hopelessness	– .37
Depression	– .40

Table 7: *Significant correlations (a ≤ .05) between return to work and postoperative psychological variables (just before discharge).*

Variable	*r*
Depression	– .47
Anxiety	– .34
Activation	.47

The significance of their content however is supported by their similarity to the predictors which could be identified for infarct patients. Langosch (1984) gives an overview of psychological variables influencing return to work of patients with myocardial infarctions. Failures of vocational rehabilitation are often found empirically with those patients who can not adjust satisfactorily to the actual trauma nor to the chronic disease. Maladaption is indicated mainly by high anxiety and depression, as well as by many emotional and somatic complaints.

The predictor of the type-A classification as found by Heller et al. (1982) has its special problems. Impatient, achievment-oriented patients with a marked competitive attitude return to their jobs more often. The type-A behaviour pattern is triggered by interaction between external conditions on the job, e.g. high demands inherent in it, and the individual psychological conditions mentioned. Jenkins et al. (1979) could show a visibly increased risk for re-infarction for type-A patients. In cardiac rehabilitation, therefore, the question is occasionally raised whether patients with borderline medical findings and an extreme type-A behaviour pattern should unconditionally be encouraged to resume work.

4. Conclusions

Bearing in mind a total of 2.2 million unemployed in West Germany, you might say that the high percentage of nonworking patients after CABS needs no further discussion. Aside from the ethical question, this point of view does not do justice to many of the heart patients in the long-term postoperative course. Self-concept and self-esteem, especially of the achievement-oriented coronary patients with a typ-A personality structure, are highly depending on work and occupational success.

Conclusions which can be drawn from the results in order to enhance vocational reintegration in this patient group refer to 3 different levels:

- the level of the individual vocational risk patient
- the institutional level and the public
- the level of further research programs in this field

4.1 Individual level

(1) Identification of the vocational risk patient prior to surgery regarding age, level of education, physical demands of job, and duration of preoperative nonworking period as well as psychological factors indicating the management of illness and surgery.

(2) Supporting the patient in coping with surgery and chronic disease. Anxiety and depression are the most common emotional reactions not only to cardiac surgery and heart disease but to all serious diseases. Supporting the patient pre- and postoperatively in dealing with these negative emotions is an important task of the whole clinical staff. Somatic preoccupation and exaggeration of cardiac symptoms are often signaling underlying anxiety and depression.

Enhancing flexibility and adaptability to change are further decisive supporting elements. Some patients have to learn that there are other forms of doing their jobs besides the extremes of excessive achievement orientation and nonworking. Since coping processes are determined by intellectual as well as by emotional factors, support of the patient may consist of different components: patient-centered medical information, group discussions, stress-management training, relaxation training as well as psychotherapeutic treatment. Supporting the patient should include encouragement to resume work.

(3) Counseling the vocational risk patient before postoperative discharge, taking sociomedical and psychological aspects into consideration.

(4) Routine cardiological check-ups during the long-term postoperative course, e.g. 4 months postoperatively and twice a year medical information may prevent subjective overestimation and exaggeration of somatic symptoms by the patient.

4.2 Institutional level

It would be illusionary to assume that the problem could be solved by patient-centered interventions alone. The following requirements refer to medical institutions, to employers and to the public.

(1) Shortening the preoperative waiting-period. Regarding the dependency of vocational rehabilitation on the duration of preoperative nonworking periods, the increase of operating capacity to shorten preoperative waiting-time is an important requirement. This holds at least for Germany.

(2) Better information of general practitioners and physicians accredited with insurers.

(3) More job flexibility on the part of employers. Making more part-time jobs available, which up till now are relatively rare in Germany, could serve as an acceptable compromise between full-time working and premature retirement, especially for those patients who have limitations of their physical capacity.

(4) Reducing prejudice against heart-operated patients among the public.

4.3 Research level

The third aspect of the problem concerns research programs in this field. Multivariate prospective studies are needed; following a biopsychosocial model, demographic, vocational, psychological and medical variables should be included. Sample sizes have to be adequate in order to weigh predictors using multiple regression analysis.

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Rehabilitation of juvenile psychosis

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1. Introduction: The three-component program of rehabilitation (Liberman)

In our rehabilitation program for psychotic juveniles, we follow Liberman's "three component model" (Liberman & Evans, 1985). This method is based on the vulnerability-stress paradigm of major mental disorders, which explains the onset, course, and outcome of psychotic symptoms as a complex interaction between biological, environmental and behavioral factors (Liberman, 1982). Psychobiological vulnerability produces psychotic symptoms when stressful life events or ambient tensions overwhelm coping skills (Liberman & Evans, 1985; Reinhard, 1985 a). We have adopted the three intervention techniques set out by Liberman on the basis of this vulnerability-stress paradigm, modified for the therapy of juveniles:

(1) training in social (coping) skills,

(2) medication,

(3) behavioral family management.

Juvenile psychotics undergoing stress need social skills to enhance problem solving and mobilization of supportive networks. Rehabilitation techniques that strengthen coping skills confer protection against exacerbation of psychotic symptoms by buffering stress and compensating for continuing vulnerability to psychosis (Liberman et al. 1980; Liberman & Evans, 1985).

It is also necessary to train the parents – in cooperation with the juvenile – to self-manage neuroleptic medication. The goal of medication is to reduce biological vulnerability and susceptibility to relapse under stress or due to environmental overstimulation caused by family tensions. Negative side effects and negative attitudes toward medication often result in noncompliance by patients and their families.

Another avenue is reducing the amount of stress in the family environment, a major cause of stress for most schizophrenics (Vaughn et al., 1984). Family supportiveness can be strengthened through behavioral management – education about nature and course of schizophrenia, training in effective communication skills, assisting family and patient to use problem–solving techniques when confronted with tension and conflict (Liberman & Evans, 1985).

In this context, coping with stress can be a valid paradigm of psychopathology of psychotic juveniles. The abundance of literature illustrates the way coping has taken from a "footnote of stress theory" (Lazarus) to its central concept. Neither the "objective" stress (stimulus) nor the specificity of stress reaction (adaptation syndrome) are the important factors but the mediation between stress and the juvenile, the transaction in the sense of an exchange process. Rehabilitation must help psychotic adolescents to achieve an adequate balance between their own capabilities and limitations on the one hand, and conflict and stress situation on the other hand. The adolescent patient is interested in a quick solution to personal and interpersonal crises. He is not at all interested to go through a "Sturm and Drang" period of adolescent age. Thus, coping cannot be limited to coping with a functional crisis, it must, rather, seek a schematization of the situation in accordance with reality (Olbrich, 1984; Döbert & Nunner-Winkler, 1984, Reinhard, 1985 b).

Broad-spectrum therapy and rehabilitation based on the vulnerability-stress model of schizophrenia must begin with an assessment of the juvenile's interpersonal problem-solving (coping) skills, evaluation of the family environment for sources of stress and support (reflected in the dominating "life motifs" or "existential themes" in the experience of the juvenile), and reduction of the biological vulnerability through optimal neuroleptic medication.

2. Diagnosis of stress, coping skills, and defense processes of psychotic juveniles

Let us begin with the diagnosis of coping skills and defense processes of schizophrenic juveniles, and stress (reduction) in their personal life space (cf. Rheinhard, 1985 a). Analyses of variance with age, sex, and social situation as covariates have shown the importance of depression and resignation, illusion formation, and defensive reaction as defensive processes in psychotic juveniles. In the course of their development, these processes gain in importance, whereas techniques of productive adjustment – social contacts, identification with peers, taking advantages of opportunities, hopefulness – show constantly lower levels compared with other diagnostic groups of juveniles. The most important life themes of psychotic juveniles are permanence of the present (stressful) situation, physical problems, absence of desire to expand the life space, and lack of joy.

In order to improve the development of rehabilitation techniques, we have compared successfully treated (N = 41) with unsuccessfully treated (N = 9) psychotic juveniles. Comparison of central tendency measures are based on t-tests; comparison of bivariate data are using contingency tables (contingency coefficient = C). (Table 1)

Table 1: *Successfully treated (N = 41) versus unsuccessfully treated (N = 9) psychotic juveniles*

1. School	*C = .44*
– none	*2 (4.9 %) / 3 (33.3 %)*
– primary	*13 (31.7 %) / 1 (11.1 %)*
– secondary	*24 (58.5 %) / 3 (33.3 %)*
– learning disabled	*2 (4.9 %) / 2 (22.2 %)*
2. Income	*C = .42*
– low	*7 (21.9 %) / 4 (66.7 %)*
3. Medication	*C = .28*
	30 (73.2 %) / 2 (22.2 %)
4. Familial stress	*t = 2.54*
	6.5 / 7.8
5. Hopefulness	*t = 2.04*
	1.9 / 0.8
6. Positive reframing	*t = 1.95*
	1.8 / 0.8

Continuous attendance of school appears to be important for the effect of therapy; one third of the unsuccessfully treated juveniles do not go to school. Successfully treated patients are more often students of secondary schools (two thirds vs. one third in the comparison group). Family income of successfully treated juveniles is higher, family stress lower. Medication seems to be very important for successful treatment. The coping strategies of "hopefulness" and "positive reframing" are also decisive.

3. Discussion: Do the empirical results support rehabilitation of psychotic juveniles by the "three component program"?

Successful attendance of school as an important developmental task for juveniles; a supportive family; neuroleptic medication; and, finally, the coping techniques of hope and positive reframing have proven to be decisive for successful treatment of psychotic juveniles. The social learning procedure proposed by Liberman & Evans (1985) and drawn from the vulnerability-stress paradigm of major mental disorders, is in line with our empirical results. "Modules" for social learning in adolescence, hence, must contain sequential exercises and videotaped demonstrations pertaining to the school context. They must be developed in a form which allows the development of a positive, hopeful view of relevant problems in this area. The importance of medication – the second part of this rehabilitation program – was also confirmed by our empirical results. It is important to win the cooperation of the entire family through education about drug action, side effects, etc.; negative attitudes towards taking drugs must be "reframed positively".

The final but perhaps most important point, also confirmed by the empirical results, is the support of the family. Strongly expressed emotions, above all negative emotions, diminish the outcome of the treatment. Training procedures are aimed at a more congenial family milieu, and education about the nature of schizophrenia and the management of the disturbance; training in effective communication, and further development of problem-solving skills are important.

Our empirical results show that rehabilitation of juvenile psychosis can best be approached in the threefold way Liberman and coworkers have proposed for chronic mental patients: "The combination of three modalities – skills training, medication . . . and behavioral family management – offers new hope in rehabilitating the chronically mentally ill" (Liberman & Evans, 1985, p. 85) – and the psychotic juvenile.

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Some considerations on control of continuous processes by speech

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1. Introduction

Human speech is a natural means of communication. Much effort is spent on speech as a possibility of man-machine communication, and systems have been developed for speech production and word recognition. The quality of the speech produced is quite good, and it is already used to produce standard messages. Speech recognition is far more difficult, and it is therefore rarely used in practice as acceptable recognition accuracy is only possible for separate words. Before a recognition system can be used a reference list of words to be recognized has to be set up (the so-called teaching procedure), in which every reference word is transduced into a digital code and stored in the memory.

When a word is pronounced during the recognition procedure, it is again translated into the digital code and compared with all the reference codes in the memory. The most similar code will be searched for. When the difference is below a certain threshold, the specific word is accepted as the recognized one. Otherwise, it will be considered as not accepted. Almost every recognizer is speaker-dependent. This means that the person who wants to use the system has to speak the reference list himself. If someone uses the system with the reference list created by another person, recognition accuracy will inevitably be lower. Existing devices are gaining an accuracy of about 95 % or more.

As already mentioned, people are very much interested in man-machine communication by spoken commands. Handicapped persons with no motor functions of legs and arms, for instance, can make use of spoken commands as an alternative way of steering an electrical wheelchair. By doing so, it has to be considered that the person is trying to control a continuous process by digital signals (commands).

2. Laboratory setup

The wheelchair is activated by commands spoken by the driver. To accomplish this, the commands are spoken into a microphone and sent to the automatic speech recognition system (Fig. 1). In this automatic speech recognition system (ASR), the command is tested for recognition. The automatic speech production (ASP) provides the possibility to verify if a command is recognized and which one it is.

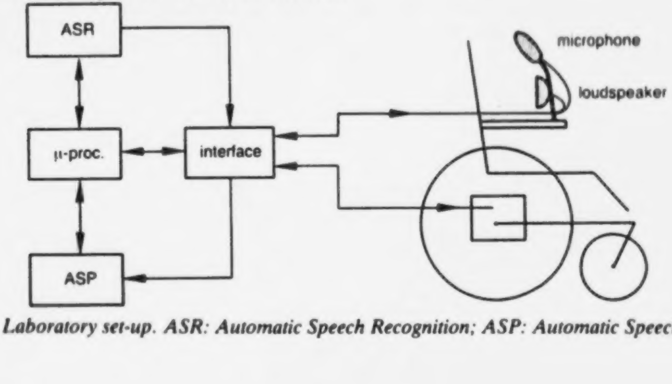

Figure 1: *Laboratory set-up. ASR: Automatic Speech Recognition; ASP: Automatic Speech Production*

The necessary combination of microphone and loudspeaker can be mounted on the wheelchair or directly put on the driver's head by means of a headset. When a command is understood, the microcomputer will receive the signal of the recognized word. The software will translated this signal into the proper steering code, which is sent to the power circuit of the electrical wheelchair.

In the case of steering by spoken commands, there will be no tactile or proprioceptive feedback. A recognized command always has the same standard effect. This effect (for instance driving speed, turning radius) is preprogrammable in the steering software, which can be specially programmed to accomodate the individual wishes of the driver.

3. Command set

An important aspect of driving an electric wheelchair by means of speech is the set of control commands. To develop a command set the situations occurring during use have to be considered. Therefore, it is important to get an overview of possible situations. A test circuit has to be developed to carry out practical experiments and evaluation studies. The trajectory is a simulation of practical wheelchair movements (outdoors and indoors), which are quite easy to analyze, They can be separated into various basic wheelchair movements (situations). Figure 2 gives a scheme of the test circuit.

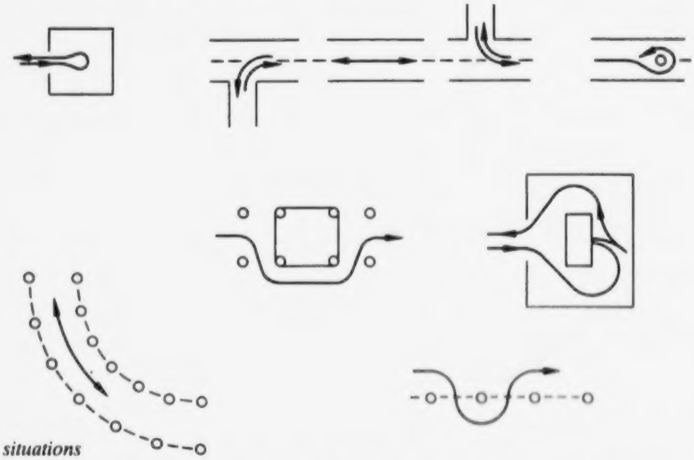

Figure 2: *Test circuit situations*

These situations were used in different experiments. Furthermore, the test circuit was used to develop the set of control commands. At first, a lot of commands were collected which wheelchair drivers would like to use in different situations. An experimental setup was made, and an assistant served as a recognition system. He selected the desired wheelchair movements and played the effectuator. According to the steering commands given by the wheelchair driver, he chose the wheelchair action by pushing a switch on the control box. The assistant could follow the wheelchair on foot, holding the control box in his hands. Each switch on the box corresponded to a fixed joystick situation. The experiment showed that different subjects used only little variations in steering commands, the commands appearing "natural". It was found that there was a great need for commands to make corrections in wheelchair movements and to be able to maneuver the chair in narrow spaces. The command set used for further experiments consisted of short "natural" words, and words that had a poor recognition accuracy or could be mistaken for other words during recognition were avoided.

4. Control strategies

Important aspects to consider are the different possibilities for control strategies. In steering an electrical wheelchair, two frequently used control principles can be distinguished: controlling the position of steering wheels (steering wheel control), and controlling the course of the wheelchair (course control). Also, a combination of these two and preprogrammed complex movements should be mentioned.

The steering wheel control is simplest. A command for changing the direction of the wheelchair puts the steering wheels in the desired position or, in case of another type of chair, both electrically powered wheels are given the desired velocity. The chair maintains the chosen action until the driver gives the next command, and so on.

Course control, in principle, is a special case of steering wheel control. However, in this case, the duration of the movement is not controlled by the driver but by the computer, and executed in such a way that the change of course is implied in that particular command. In doing so, it is possible to carry out very small changes in course with one command.

Steering an electrical wheelchair by speech should use a combination of steering wheel control and course control. Major changes in direction can be carried out by steering wheel control, and the small changes (the corrections) by course control. A schematical example for speech controlled wheelchair is given in the position diagram of Figure 3. The fixed states for steering wheel control are shown by the closed circles. Changes from one position to another are accomplished by recognizing the particular command. These changes are shown by the large arrows. Furthermore, correction possibilities (course control) in some fixed states are shown by the dotted circles and arrows.

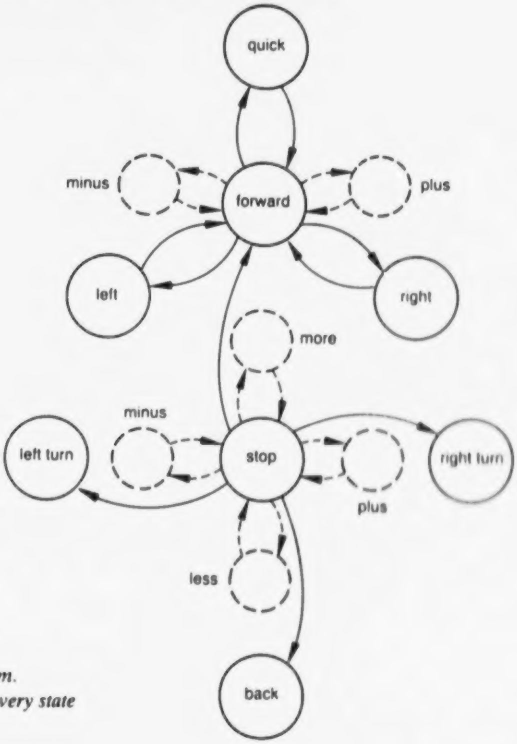

Figure 3: *State diagram.*
"Stop" is possible in every state

An example of a possible compound motion is given in Figure 4 (a lateral displacement). This movement will be executed by one command. Otherwise, several commands have to be given to achieve the same result. Experiments showed that steering wheel control as the basic principle, combined with some course control commands for driving corrections and for maneuverability in small spaces, yields good results. During transfer of the wheelchair from one fixed position to another, the driving behavior is adapted by the software to achieve smooth transition. This transition can also be adapted to the needs of the individual driver.

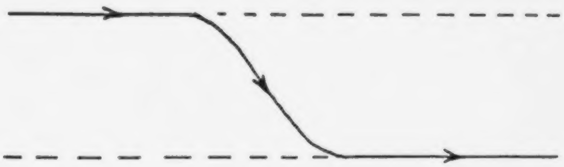

Figure 4: *Lateral displacement*

5. Reliability and safety

Much attention has been paid to making speech control more reliable. Some precautions have been taken to increase recognition accuracy. Commands can be pronounced quite differently during operation of the wheelchair. By capturing these different pronunciations in a multiple reference list, the reliability of the operation can be increased.

When the chair is in a steady state (see Fig. 3), only specific commands are relevant. For instance, when the chair is moving forward, only the commands that belong to this state and can follow on "forward", need to be recognized (stop, quick, left, right, plus, minus). The software puts a kind of mask over the reference list in such a way that the recognition system will only check for relevant commands. This is possible in every fixed position.

Yet, unwanted situations can occur. The command "stop", used in panic, will hardly be recognized because the discrepancy with the reference pattern will be too great. It therefore is necessary to provide a hardware stop for emergencies, which can be realized by a switch operated by the head. When the chair is in the "stop" state, it may happen that, during a conversation, a command is recognized. This is a very unsafe situation, and the recognition device can be put into a kind of "dormant" state, for instance by the command "stand". In this state it will only recognize the word "listen", and will then go back to the "stop" state.

6. Conclusions

Experiments have shown that controlling a wheelchair by spoken commands requires to become familiar with the whole setup. It takes a lot of training to attain reasonable recognition rates and to get used to the reaction of the wheelchair to the different commands (driving behavior). Familiarity with the commands permitted and with the control strategy is essential.

Although not all experiments have been completed, the best strategy seems to be a combination of steering wheel and course control. Especially for maneuvering, preprogrammed actions for small steps backward and forward and small steps to the left and right, are indispensable (commands "more", "less", "plus", "minus"). Much attention has to be paid to the command set, recognition rate, control strategy, safety and training, in order to achieve optimization.

Rehabilitation after hip replacement: A one year follow up

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1. Introduction

In Britain the elderly constitute the major consumer group for hospital care, occupying approximately 50 % of all National Health Service (NHS) acute beds. In addition, a high proportion of specialties not dealing specifically with the elderly have a large fraction of elderly patients. Thus 52 % of general medical beds are used by the over 65s; the corresponding figures are 44 % in orthopaedics, 41 % in general surgery, and 54 % in ophthalmology.

One of the major operations carried out on older patients is hip replacement. In 1979, 20,280 total hip replacement operations were undertaken in England. By 1983 this had increased to 25,190. This represents a substantial input of resources by the NHS. There has however been relatively little attempt to evaluate the effectiveness of this type of surgical intervention in terms of its impact upon the ability of the elderly to live an independent life in the community. Using data from an extensive survey of the elderly after discharge from hospital (Victor, 1984), this paper examines the progress of a sub-group of patients treated for total hip relacement.

2. Method

A 4 % random sample of patients aged 65 years and over, 2711 subjects, discharged from general hospitals throughout Wales was selected from Hospital Activity Analysis (HAA) records kept by the Welsh Office in Cardiff. Included in this study were 120 patients treated for hip replacement. Entry into the study was restricted to patients with a minimum stay of 48 hours in hospital to exclude those admitted for tests. The sample was collected monthly for one complete calendar year (1981) to exclude the influence of seasonal variations in admission patterns upon the results. The study was undertaken in Wales which, in 1981, consisted of 8 Health Authorities. Seven of these authorities were included in the study. Powys was excluded because it lacked an acute general hospital.

Three and twelve months after discharge, subjects were sent a postal questionnaire which had been subject to extensive methodological development. This method of data collection was used because the geographical scatter of the study population made the cost of employing field workers prohibitive. Subjects were sent a covering letter with the questionnaire explaining the purpose of the study and a reply paid envelope in which to return their completed questionnaire. Reminders were sent at one and two months to those who had not returned their questionnaire. The three month questionnaire collected information about the demographic and household status of individuals, their use of services and the preparation they had received, whilst in hospital, for their discharge. Data were also collected about the physical status of subjects. In addition, subjects were asked to rate their level of disability in the month before admission. The twelve month questionnaire collected data about the rehabilitation of subjects and their use of services.

Rehabilitation is a difficult concept to measure, especially in studies of the elderly. Studies of younger subjects have traditionally been of little use for a study of the elderly, where only about 5 % are employed. Medical recovery, as defined by the absence of symptoms, is another index which has been used with younger subjects. Again, however, its usefulness for a study of the elderly is doubtful as the presence of multiple pathology may preclude full recovery. In this study rehabilitation was conceptualised in terms of functional capacity, that is the ability to lead an independent life at home after discharge. This definition of rehabilitation is in line with the recommendations of the Tunbridge (1972) and Mair (1972) reports.

Three measures of outcome or rehabilitation were used in this study: functional capacity, patients own ratings of their rehabilitation, and mortality. Functional capacity was recorded using the nine item index first described by Townsend (1979). This requires subjects to describe their ability to perform a series of tasks considered essential to an independent life in the community, such as shopping and cooking. Tasks which are performed without difficulty are scored O; those which are done with difficulty are scored 1, and tasks which the subject cannot perform unaided are scored 2. Thus, the index has a range of 0 to 18. Townsend then classifies respondents according to the following typology. Scores of O are defined as not disabled; 1–7 as mildly disabled; 8–11 as moderately disabled, and 12 and over as severely disabled.

At both interviews subjects were asked to assess their rehabilitation using two questions which have been used in previous studies of the elderly after discharge from hospital. The first asked "Are you back to normal now: that is can you do all or most of the things you could do before admission to hospital“ (Gay & Pitkeathly, 1977). The second used by Hirst (1975) asked "After your stay in hospital, did your health improve, get worse or stay the same.“ Data about subjects admission and stay in hospital were derived from the HAA form.

3. Results

The results of the study are described in several sections. The first describes the response rates. In the second, we describe the characteristics of patients discharged after hip replacement and compare them with a sample of all discharges. The third section describes the process measures of length of stay in hospital and use of services post discharge. The final section describes the outcome three and twelve months after discharge.

3.1 Response rate

The response rate for the hip replacement group was 92 % (110/120) at 3 months and 90 % (99/110) at 12 months. This was higher than the response for the whole group, which was 83 % and 85 % respectively. No evidence of non-response bias was found when the characteristics of non-responding hip replacement subjects were compared with responders.

3.2 Patient characteristics

(a) Demography

The majority of hip replacement patients, 67 %, were females, and 56 % were aged under 70 years (Table 1). This contrasts with a random sample of discharges of the over 65s where 59 % were female and 49 % were aged under 70. No patients, in either group, were resident in an institution before admission.

(b) Pre-admission morbidity

Pre-admission disability was very high in both groups. As this assessment was based upon subjects' own ratings of their abilities in the month before admission, these ratings could be subject to recall bias. For example, subjects might be more pessimistic about their health status from a retrospective perspective. However, the methodological work undertaken during this study suggests that this was not a significant problem. In addition to limit the

Table 1: *Characteristics of the sample (%).*

	Hip Replacements	*All Discharges*
Sex		
Male	33	41
Female	67	59
Age		
65–69	25	22
70–74	31	27
75–79	19	25
80+	25	26
Disability		
None	9	25
Mild	26	27
Moderate	19	19
Severe	42	25
Health Rating		
Good	35	37
Fair	53	46
Poor	9	15
N	110	1930

Table 2: *Preparation for discharge (%).*

	Hips Group	*All Discharges*
Less 24 hours notice	23	37
Discuss return home	81	67
Discuss need for help	65	44
Discharged right time	77	75
Too Soon	10	11
N	110	1930

Table 3: *Use of services at 3 months (%).*

Service	*Hips Group*	*All Discharges*
Home help	33	25
Meals on wheels	13	8
Social worker	27	23
District nurse	46	37
Health visitor	17	15
GP	75	68
Outpatient visit	71	64
Day hospital	17	18
Physiotherapy	24	8
N	110	1930

impact of recall bias, we discuss patients disability classification rather than individual scores.

Table 1 shows that 42 % of hip replacement patients were classified as severely disabled before admission, compared with 25 % of the whole replacement group. Table 1 also shows that they were more optimistic about their health status than the whole group. Thus, only 9 % rated their health as poor compared with 15 % of the whole sample.

(c) Hospital admission

90 % of the hip replacment group were admitted from the waiting list, compared with 24 % for the whole sample. The mean time that they waited for admission was 16 weeks, although this ranged from 2 to 14 months. Mean waiting time varied between the 7 participating areas, being longer in the northern rural counties than in the industrial south.

3.3 Process measures

(a) Length of stay

Hip patients had a shorter length of stay in hospital than the whole group; 50 % were in hospital for less than 14 days compared with 40 % of the main group. The mean duration of stay was 10 days for the hips group, and 15 days for the main sample.

(b) Preparation for discharge

Subjects were asked about the preparation they had received for their discharge whilst they were still in hospital. Table 2 compares responses to these questions between the hips group and the whole sample. Patients who had been treated in the hips group were given longer notice of their impending discharge and were more likely to report that their return home and need for help at home had been discussed than the main group. Subjects were asked if they felt that they were discharged at the rigth time, or if they felt they should have stayed in hospital longer. There were no differences between the two groups in the response to this question, with three quarters of both groups feeling that they were discharged at the right time. However we see that a substantial minority, 10 %, felt that they had been discharged too soon.

(c) Readmission

Within 3 months of discharge, 16 % of the hips group had been readmitted as an inpatient; the annual readmission rate was 30 %, compared with 54 % for the whole group.

(d) Use of services

As Table 3 illustrates, the use made by the hips patients of community services within the first three months after discharge was very much higher than that typical of all elderly at a similar period post discharge. With the exception of visits to the day hospital, the hips group were more likely to receive services than the whole sample. 33 % of hips patients received a home help, and 75 % had seen their GP, compared with 25 % and 68 % respectively for the whole group.

3.4 Outcome

Each of the outcome measures are described in turn.

(a) Mortality

At 3 months, 9 % of the hips group had died; the annual mortality was 11 %. Mortality for the whole sample was 12 % and 20 % respectively.

(b) Functional capacity

Subjects pre-admission disability classification was cross-tabulated with the three and twelve months classification. Thus we are able, in a very crude way, to assess how hospital treatment and discharge have influenced the ability of subjects to perform a series of tasks considered vital to an independent life in the community.

Because of our reliance upon retrospective data for the baseline disability rating, we compared classifications rather than individual scores. We felt that the classifications would be more robust than individual scores because we thought they would be less affected by recall bias. However, this does mean that we may understate the amount of change in functional capacity. Thus subjects may change their overall disability score by several points but not change disability categories. The typology of change used was: subjects who had the same classification were categorized as unchanged; those who have an improved rating are described as better, whilst those with a worse classification are described as worse.

The majority of subjects, in either group, were in the same disability group as before admission (Table 4). This suggests that hospital admission has had very little impact upon subjects level of functional capacity. However, this Table does show that, whilst only 6 % of the whole sample were classed as improved, 20 % of the hips group were so defined. Also, fewer hips patients were categorized as worse compared with the whole group. Performing the same analysis at twelve months we see that the hips patients are rather less optimistic about their abilities than they were at three months. There is very little difference between the two groups in the fractions of subjects classed as improved. Only 5 % of the hips patients were classed as improved compared with their pre-admission rating, compared with 17 % of the whole sample. This represents a marked decline in outcome compared with the situation at 3 months. However, hips patients were less likely to be classed as worse than the whole sample.

Changes in outcome were analysed in terms of the demographic characteristics of patients and details of their stay in hospital. For both groups, older patients were much less likely to record changes in disability, in either direction, than younger patients. In the hips group, changes in disability were not related to the length of time subjects had waited for admission to hospital. Again for both groups, patients who felt that they had been discharged from hospital too soon were most likely to record changes in disability for the worse.

Table 4: *Changes in disability (%).*

	3/12		*12/12*	
	Hips	*All*	*Hips*	*All*
Better	20	6	5	17
Worse	9	19	25	32
Same	71	68	60	46
N	110	1930	99	1404

Table 5: *Subjective rehabilitation ratings (%).*

	3/12		*12/12*	
	Hips	*All*	*Hips*	*All*
Back to normal	47	49	42	45
Effect of treatment				
- Improved health	45	47	38	40
- Worse health	1	7	20	15
- No change	48	43	41	45
N	110	1930	99	1404

(c) Subjective ratings

Table 5 describes responses, at three and twelve months, for both groups, to the subjective rehabilitation rating questions. At three months, less than half of both groups felt they were back to normal or that hospital treatment had had a beneficial effect upon their health. Interestingly, there is a trend for members of both groups to become less optimistic about their rehabilitation with increased length of time after discharge. Thus, at three months, 45 % of the hips group felt that treatment had improved their health compared with 38 % at twelve months. This compares with 47 % and 40 % respectively for the whole group.

4. Discussion

Using data from a wider survey of the elderly after discharge from hospital, we have described the progress of a sub-group of patients treated for hip replacement three and twelve months after discharge. The study was conducted throughout Wales using a postal questionnaire to collect the data. Response rates to the questionnaires were good and were comparable to those obtained by direct survey interviews of the elderly. No evidence of significant nonresponse bias was identified.

We saw that, compared to the main study group, hip replacement patients were younger and contained a higher fraction of females. They were also significantly more disabled than other members of the study group. However, they were more optimistic in their subjective rating of their health than the wider sample.

The majority of patients treated for hip replacement were admitted from the waiting list after an average wait of 18 weeks. This group were better prepared for discharge in that they received longer notice of their impending discharge and where more likely to have had discussions about both their return home and their need for help once back home. This better preparation for discharge probably reflects the planned nature of the admission. However, there was no difference between the two groups in the fraction of subjects feeling that they were discharged from hospital too soon.

Readmission rates were self reported, as it was not possible to obtain these data by record linkage. Readmission rates were very similar in both groups, and half of all readmissions were for further treatment for the patients original medical condition.

Use of services amongst both groups was extremely high compared with ordinary members of the elderly population. Hip patients had a higher level of service use at both three and twelve months than was typical of a sample of all discharges. This, however, was not simply an artifact of a higher level of usage by the hips group before service usage. The data also suggest that the high demand placed upon services is not confined to the immediate post-discharge period but is maintained for at least a year after discharge especially for the domiciliary services, such as home help or meals on wheels.

Because of the difficulties of measuring outcome and rehabilitation after discharge, three separate measures were used in this study. Mortality, at both three and twelve months, was lower in the hips group compared with the sample as a whole. For both groups changes in disability rating at three months, compared with before admission, were confined to the minority. However, we did observe that, at 3 months, more hips patients were categorized as improved compared with the whole group. At twelve months, this improvement was not maintained, and there was a trend for both groups to indicate a deterioration in outcome. Similar trends have been observed in other studies which have followed up patients after discharge from hospital (Ferguson & MacPhail, 1954).

Changes in disability after discharge, for either better or worse, were typically confined to younger subjects. For hip patients the length of time they had waited for admission did not seem to influence outcome. However, patients with the worst outcomes were those who felt that they had been discharged from hospital too soon. The patient-provided ratings of rehabilitation showed a similar trend to deteriorate with increased length of time after discharge.

Thus, we have shown that, for patients treated for hip replacement, the improvements in functional capacity recorded in the immediate postdischarge period are not maintained in the long run. Because these findings are based upon an analysis of a sub-group from a more general study, they should be treated with some caution. However, given the importance which hip replacements have assumed in the care of the elderly, our findings that these operations have little effect upon functional capacity and that outcome deteriorates with increased time after discharge, merit further investigation in a more rigorous study.

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Emotional stress or acceptance: Parental reactions to unexpected developmental processes

A. Fritz, Cologne (Fed. Rep. of Germany)

The subject presented is related to the consequences of cerebral dysfunction. Cerebral dysfunction is a disorder with an organic cause, the development of this disorder, however, depending to a large degree on environmental conditions. Due to these environmental conditions the disorder can either be compensated or result in a learning disorder.

The importance of environmental conditions for cerebral dysfunction, compared to other handicaps, can be seen in the fact that deviations appear during the child's development only. Whether, or how far, the perceived deviations become a learning disability, will depend on the reactions of the social environment. As parents are the first persons to be faced with the deviations of their child, our main point of interest was to find out how parents react to the child's problems in learning and performance, and how the parents' reactions affect the child's development.

As long as parents have no knowledge or further information about the existence of their child's cerebral dysfunction, they bring up their child according to their own ideas of what is best for it. These individual ideas and convictions are defined as educational concepts. It can in general be assumed that parents have specific concepts of the physical and psychological development of their children. These subjective concepts imply assumptions of how educational objectives can be realized. Developmental deviations are registered when a discrepancy between expected and actual development is perceived. The underlying educational concepts also include explanations of developmental deviations and, as a consequence, determine parental reaction towards their children's behavior.

25 interviews were conducted with parents of children with cerebral dysfunction to analyze the problems involved in how parents identify developmental deviations of their children, how they explain them, and how they react to them. All parents interviewed had been informed of the diagnosis when their children were between 8 and 10 years old. The interviews revealed that the first peculiarities which aroused parents' attention are in the motor and social areas (Fig. 1): hyperactive behavior manifests itself in general restlessness, poor balance and in a strong need for movement; according to parents' descriptions delayed motor development manifests itself in inadequate motor behavior and lack of stabilization of motor behavior.

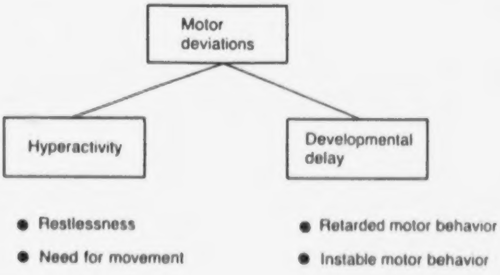

Figure 1: *Motor peculiarities*

Concerning social behavior, parents in general mentioned the inability of their children to adapt to social situations, manifesting itself in both aggression and anxiety.

Deviations in the child's approach to learn and perform are generally not detected until the child starts to attend elementary school. These deviations refer to both cognitive and motivational problems (see Figs. 2 and 3). Parents mentioned the following cognitive deviations: the child's learning behavior is delayed; cognitive processes are unstructured; cognitive processes are rigid, meaning specific cognitive patterns cannot be transferred to similar cognitive problems; cognitive performance is primarily concrete thinking. On the other hand, the children have to expend greater learning efforts: they have problems in understanding; a poor memory; low retention.

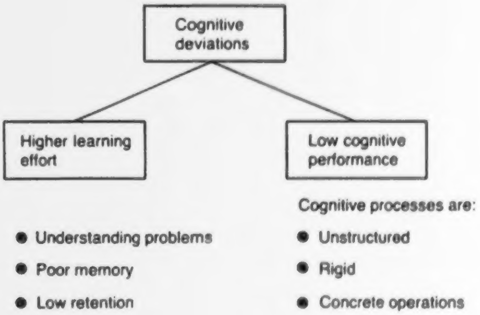
Cognitive deviations
Higher learning effort
Low cognitive performance
Understanding problems
Poor memory
Low retention
Cognitive processes are:
Unstructured
Rigid
Concrete operations

Figure 2: *Cognitive deviations*

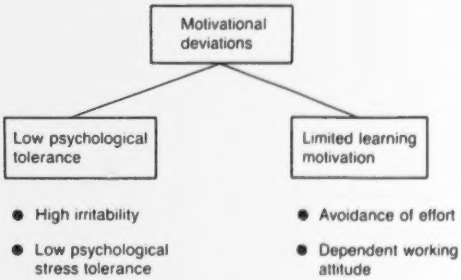
Motivational deviations
Low psychological tolerance
Limited learning motivation
High irritability
Low psychological stress tolerance
Avoidance of effort
Dependent working attitude

Figure 3: *Motivational deviations*

Motivational deviations mentioned by parents were: increased irritability, implying low attention focussing and short attention span; low psychological stress tolerance; a tendency to avoid effort; a dependent work attitude.

Parents react differently to these deviations. We found two characteristic forms of reaction (Fig. 4), i. e.: parents experience the developmental deviations as emotional stress; and parents find intellectual explanations for developmental deviations.

If parents experience developmental deviations as emotional stress, disappointment about the child is predominant. The child did not live up to their educational concepts and did not fulfill their expectations (e. g., "to be the center of their life", "substitute for a profession").

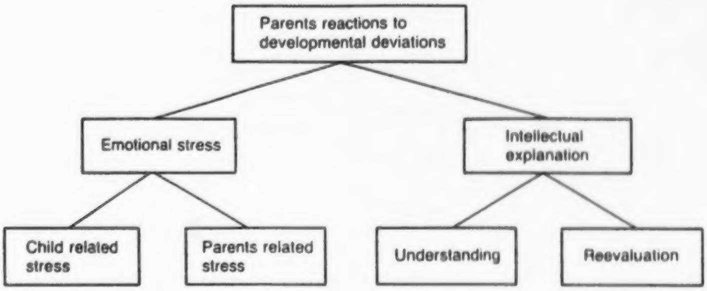

Figure 4: *Parents' reactions*

Reactions to emotional stress concern the child itself: parents have difficulties to care for their child emotionally, the child is rejected; and, on the other, parents experience stress for themselves: they suffer from depressive emotions.

In this situation the question about the cause of developmental deviations is often raised. Two different types of reactions can be found in this respect: parents blame their child, they regard their child as different from others (external explanation); parents blame themselves, they believe they made mistakes in their education (internal explanation).

But there are also many parents who try to understand their child's deviation. If this understanding is possible, emotional stress is not experienced. In particular, the following intellectual explanations were given by parents: developmental deviations are the results of changes and of family situations; developmental deviations are inborn. Developmental deviations are also experienced as unproblematic if former educational objectives are reevaluated. This is done by: relativization of the developmental deviations ("some children just develop slower than others"); reappraisal of the importance of educational objectives ("of course I wanted my child to be a good student, but today I find it is more important that he is a happy child").

The main difference between these two attitudes results from the different importance parents attach to the deviations. Parents suffer emotional stress if the educational objectives have a high value for them, and to meet these objectives they demand too much of the child. If this is the case, the child worries about its own inability to master specific tasks and the parents' disappointment. These negative emotions in parents and child seriously affect the relationship between them.

Parents who have intellectual explanations for their child's behavior do not attach personal importance to the child's deviation. They adapt their developmental objectives to the individual abilities of their child by reevaluating or delaying the objectives ("perhaps it develops extremely slowly and only needs more time and patience"). This attitude does not affect the relationship between child and parents negatively, but makes it possible to give the child support in respect to its own abilities.

The results of the interviews show that counselling of parents is of crucial importance for the development of children with cerebral dysfunction. The aim of counselling must be to increase parental acceptance of the child's deviation in order to improve the relationship between child and parents as well as the developmental conditions for the child.

The availability of physiotherapy services within the National Health Service – changing trends in England and Wales

C. Partridge, London (United Kingdom)

Physiotherapy rehabilitation of patients in Britain since the inception of the National Health Service in the 1940s has taken place mainly in hospitals or large rehabilitation centres. Patients are coming to the therapist to receive advice, treatment and management, either staying in the hospital or centre or coming as an out-patient. Though I realise that organisation of medical care is rather different in some European countries, I understand it is still the case that most patients would receive physiotherapy at a clinic or centre rather than be visited by the therapist.

In Britain, over the past 10 years, there has been a change in emphasis in the delivery of physiotherapy services – with increasingly more patients being offered physiotherapy either in their own homes or places of residence or other centres more convenient for them. Children are seen at school (special or normal school) to save missing out on education. The central concept behind this development was the provision of a more flexible service that could respond appropriately to each patient's needs, rather than offering a service in a way which was perhaps easier to administer, and expecting patients to fit into the system.

Since 1975, we have been examining the development of physiotherapy in the community in England and Wales. In 1975, we undertook a study for the Department of Health and reported in 1977 with detailed descriptions of the work of therapists in the community, the patients being seen, and the conditions being treated, as well as many other aspects of the work. Following this, the Department of Health issued a health notice revoking their earlier recommendations that physiotherapy should only be undertaken in hospital, and encouraged health authorities to consider the need for community services in their own district. Five years later, we decided to survey all health districts and determine the extent of development of community services.

We found that there had been considerable development, and we undertook a further survey in 1984 to continue monitoring the growth of these services. Table 1 gives details of the number of services available by Health District (there are approximately 200 Health Districts in England and Wales). The numbers given are actual numbers of services. We found that health districts might have one or more different types of specialised community service; 26 % of districts has no service in 1980, which was reduced to 13 % by 1984.

Table 1: *Number of community physiotherapy services in England & Wales.*

Year	Number	Percentage of health districts with a service
1975	36	2 %
1980	233	74 %
1984	370	87 %

Specialised services had developed in many areas, those most frequently reported are services for the elderly, children, for people with mental handicap, problems of general mobility, for people with stroke, with respiratory conditions, and for those who were terminally ill. The patients were being seen in a wide range of different places, but more commonly in their own homes.

Because there has been little scientific evaluation of any aspect of physiotherapy practice, it was not possible to compare the outcome of treatment and management of patients in hospital with that given in the community, as information about the evaluation of the outcome of physiotherapy in most cases is lacking. But it would be interesting to consider briefly whether there is any evidence to support the fears of some of those who are against these developments.

Firstly, that it is a waste of resources – it is certainly possible to waste resources through poor organisation, but we found that some therapists working in the community had a similar case load of patients working outside the hospital, as working in it. We were also told by some therapists that they saw the patients and assessed their problems, and as soon as they had been relieved, the visits would cease, with perhaps the therapist going back in a few days just to check on progress.

Are referrals from doctors who are not consultants or specialists likely to be inappropriate? Here again, we found no evidence of this; therapists are saying that they occasionally got inappropriate referrals from family practitioners but no more frequently than from the specialist consultants.

For some patients, particularly the disabled with multiple problems in their daily lives, physiotherapy treatment and management can be most appropriately given in the setting where these problems actually occur, with relatives and other carers included in the total programme.

We have little information at present on how training in an unfamiliar hospital or clinic setting transfers into the home environment, and what information there is suggests that there may be difficulty in transferring mobility skills from the hospital to the home setting. This is not to say that we do not need hospitals or rehabilitation centres, but there is a need for rehabilitation services to be more flexible and able to respond to individual needs. And the only way to do this for physiotherapy is clearly to be able, when necessary, to deliver services where it is most appropriate for the patient, i. e. patient-centred service, not a hospital or clinic orientated one.

In the future, when a decision is made for a patient to receive physiotherapy, not only should the most suitable treatment and therapist be selected, but the place patients will receive treatment should not be rigidly fixed, but their needs considered as paramount.

We still have a long way to go in Britain, though there has been quite a marked expansion of services, with a trend towards most health districts offering community physiotherapy services. But only a very small proportion of therapists, perhaps around 15 % of the profession, actually undertake any work outside the hospital.

Though services in different countries are funded in different ways, whether they are nationally funded through subscription but free on delivery, or covered by insurance, or on a fee-for-service basis, patients with problems of physical disability need to be offered a more flexible, patient-orientated service. This will not necessarily greatly increase the number of therapists needed. More appropriate treatment, given in the place most suitable for each individual patient may, in fact, decrease the overall physiotherapy time.

A model for coordinated and integrated lifelong maintenance of health

F. Haux, Bad Sachsa (Fed. Rep. of Germany)

When efficiency and effectiveness of public health services are discussed, the established system of professional medical care comes under criticism. Innovative goals and new organizational structures in medical care are necessary if society wants to be able to meet the subjective and objective demands of today. The following examples show the urgent need for change. Surveys have shown that every second person in Germany believes health to be most important, but only one fourth of the population is willing to lead a healthy life. It is estimated that about 70 % of persons feeling ill avoid professional medical care and help themselves or obtain help from their relatives and other non-professionals. Another aspect is the current political and economic situation, which calls for a reexamination of the structure of expenditure for medical care totalling about 200 billion DM last year.

1. The hypothesis

Effective and efficient health protection is only possible if a lifelong strategy to ensure health is established, in which all health service professions participate backed by lay helpers and self-help groups. The decisive share of taking care of health must take place at home, implemented by familiy physicians, community nurses, social workers, self-help groups, and with active involvement of lay people. Today, in view of the increasing number of chronic illnesses, self-help is the most important element of modern health strategies. Self-help requires knowledge, understanding, experience and testing; successful health maintenance calls for some major adjustments in the patient's way of life; these can only be achieved within the framework of a medical care system with outpatient and inpatient features, in which the patient can be successfully motivated within his familiar social environment as well as in a learning-oriented situation where the patient is the center of attention, like "undergoing a cure". Undergoing a cure can only be the beginning of a lifelong practice of taking care of one's health, which is only effective and economically justifiable if the outpatient phase that follows guarantees continuation of the therapeutic goals. The aim of lifelong safeguards for health is an affirmative attitude towards a healthy lifestyle and a patient who assumes responsibility and knows that it is his own health he is taking care of. He should also know that even a perfectly working health service system cannot protect against the personal consequences of illness. He should be aware of the fact that he can only stay healthy if he knows the functioning and structure of his body, and if he accepts that acute and chronic diseases are caused by risktaking, implying faulty behavior which can only be corrected by lifelong taking care of one's health on the basis of self-help principles. In the following, a model for a coordinated and integrated lifelong health maintenance system is outlined.

2. The model

2.1 The inpatient phase

The inpatient phase – "taking the cure" – of this lifelong health strategy takes place in the AOK-Kurklinik Pfaffenberg in Bad Sachsa. It is a health center for preventive and rehabilitative medicine. Under the guidance of an internal chief physician, 102 patients insured by the AOK Niedersachsen (health insurance of Lower Saxony) are taken care of by doctors, nurses, social workers, masseurs, physical therapists, and dieticians. The program is especially designed for patients at risk.

2.1.1 Complementary services

Besides providing adequate medical treatment, the AOK-Kurklinik Pfaffenberg offers interventional psychological, educational and social programs comprising the following elements:

(a) Instructions for self-help: This is the most important component. It consists of physical training with general and specific gymnastics, affect management, techniques to control body functions, physical treatment, first aid, diet cooking, etc.

(b) Health information: Knowledge and understanding are necessary to change behavior. Every day all members of the medical staff take part in an one-hour round table session informing the patients about general and specific aspects of health by means of various media.

(c) Behavior therapy: New patterns of behavior are shaped and tested by way of behavior therapy.

(d) Life style analysis and life style guidance: Since most chronic diseases have multiple causes, it is necessary to consider the entire human being including his social environment. The data collected are essential for the treatment as a whole, and particularly for change of behavior.

(e) Organization and guidance of leisure time activities: The growing qualitative and quantitative significance of free time requires that attention be paid to leisure time activities. While the patient takes the cure leisure time is organized with the help and cooperation of the patient.

(f) Medical care: Medical diagnostics and therapy are adapted to the Kurklinik. In cooperation with health care professionals, lifelong health maintenance procedures are initiated.

2.1.2. Cure procedure

Depending on their physical conditions, patients are divided into small groups which are guided by a therapist. Every patient performs his specific cure program tailored to his physical condition. The cure program goes through the following steps: in the first phase the patient is required to forget his daily routine and concentrate on himself. In the second phase he tests the therapeutic services. In the third phase, every patient has to consider how he can establish this new life style in his everyday life especially with regard to the personal and environmental conditions at home.

2.2 The outpatient phase

All cognitive, affective and physical progress made during the inpatient phase and the resulting new life style must now be transferred to everyday life. It stands to reason and is indispensable that the family physician continues the medical treatment at home and safeguards the success of a lifelong health maintenance regimen. Apart from him, it is essential that community nurses, persons in charge of rehabilitation at the health insurance companies, and social workers participate because they are acquainted with the patient's environment and his home.

2.2.1 Methodological procedures

To secure the progress made during the cure it is necessary that the strategies can be implemented at home, in the everyday life and working situation of the patients, and that most parts of the treatment are being picked up at home and continued. It is the goal of this outpatient phase to achieve a permanent change of life style. Successful outpatient care should contain the following services:

(a) General post-cure care: By way of meetings every patient should evaluate the outpatient phase. Every patient has to test the intended new life style with the help of a health care team. It is important to stabilize the newly learned behavior and to take advantage of the newly developed self-confidence and vitality, so that the patient keeps giving up risk behaviors during the outpatient phase without embarrassment.

(b) Special post-cure care: If necessary, these special meetings should include the social network of family members, relatives, social workers etc. It is up to the interdisciplinary health care team to convince family members and friends of the necessity and lifelong continuation of the change of life style.

(c) Health information: Health information can be part of the program mentioned above and be offered by itself; it is a specific task of the physician.

(d) Setup of self-help groups: The establishment of self-help groups should be initiated as soon as possible. Later on the health care personnel could act as advisors to the groups established.

(e) Medication and social therapeutic help: In special cases consultation of or involvement with other institutions should be facilitated.

2.2.2 Model experience

The coordinated follow-up care by the family physician is being established in Lower Saxony in cooperation with the "Kassenärztliche Vereinigung" (National association of panel doctors) and the AOKs (Health Insurance Offices).

Interested physicians will be informed in special meetings about outpatient care of patients who have already gone through the inpatient phase with its special program. For two years there has been intensive cooperation with the social workers and the persons in charge of rehabilitation at the AOKs in Lower Saxony. Apart from personal care, information days and training for patients at risk are offered, self-help groups are advised or initiated, and addresses of social welfare organizations are provided. Another project of cooperation between the Technical University of Braunschweig-Wolfenbüttel, the AOK Kurklinik Pfaffenberg and the AOK Braunschweig has begun two years ago. Students try to establish post-cure groups for patients seeking social support and contact, leisure time activities or health information. Furthermore the student interns contact family members and friends in order to reinforce the inpatient phase. Before starting the cure patients are informed by the students about the program which they are about to enter in the AOK Kurklinik Pfaffenberg in Bad Sachsa. The students participate in several program components so that they become familiar with their clients. The response is surprisingly positive. More that 50 % of the patients on average come to the fortnightly meetings. The outpatient phase conducted by physicians, community nurses, social workers and health insurance staff is supported by the local AOK offices.

The role of the physiotherapist in motor neurone disease

K. Burford, Edinburgh (United Kingdom)

Motor neurone disease is a progressive degenerative disorder, affecting the motor nerve cells of the spinal cord and the brain stem, and to a lesser extent the larger motor neurones of the parietal cortex. There are three main types of recognised clinical presentation.

(1) Progressive muscular atrophy – affecting the lower motor neurones of the spinal cord.

(2) Amyotrophic lateral sclerosis – affecting the upper and lower motor neurones of the spinal cord.

(3) Progressive bulbar palsy – affecting the motor neurones of the brain stem.

As the disease progresses, patients may develop more widespread involvement and are therefore less easily categorised.

It is a relatively uncommon disease with an incidence of about 1.5 per 100 000 population, and a prevalence of about 5 per 100 000 population, and its management tends to be limited to a great extent to physiotherapists working in a hospital based neurological setting.

In Edinburgh, a team has been set up to deal specifically with the needs of the motor neurone disease patient. This team consists of a consultant neurologist, two occupational therapists, a physiotherapist, a speech therapist, and a nurse/counsellor who is also a member of the Scottish Motor Neurone Disease Association. To date we have seen 36 patients.

More specifically, the role of the physiotherapist within this team covers the following areas:

1. Support and counselling: The neurologist and nurse/counsellor explain the nature of the disease and its implications to the patients and their families, but patients may speak more freely in their individual therapy sessions so the therapist must have a sound knowledge of the disease. Regular team meetings are held to ensure that each member of the team is kept up to date of the patient's current problems.

2. Assessment of motor and functional disability: An initial assessment of motor power is carried out by Oxford Scale and myometry. However, the latter is largely replaced at later attendances by a functional assessment covering all activities of daily living (Figure 1).

3. Exercise: The role of exercise in motor neurone disease is controversial, and few control studies have been recorded. Lenman describes 6 cases who were given programmes of isometric exercise over various periods, and his results are shown in Figure 2.

The first graph (a) represents a 70 yr. old male and shows an increase in strength from 15–21 lbs following isometric exercise to the R. triceps. The second graph (b) shows the same patient, re-admitted at a later stage in the disease. A similar programme of exercise to the L. biceps failed to show any increase in strength. Graph (c) represents a 46 yr. old male whose diagnosis of motor neurone disease was based on a 10 yr. history of weakness and fasciculation. He showed an increase in strength in the R. triceps but also an increase in fasciculation. Graph (d) represents a 57 year old female who failed to show any increase in strength, as did the other 3 patients in Lenman's study. In his summary, Lenman concludes that "Weakness resulting from degenerative disease of the nervous system is not affected by exercise, unless the loss of strength is the result of disuse."

We attempted, and continue to attempt, to repeat this work with our patients, but with no clear benefit, and patients found the lack of benefit distressing. A 63 yr. old lady's grip strength failed to show any increase in strength over a 4 week period of isometric exercises, as did a 57 yr. old lady's quadriceps strength. Other patients showed a similar picture.

Figure 1: *Functional assessment of MND patients*

Name . . . . *Date* . . . .

Activity	*Grade*	*Comments*
1. Rolling to right		
2. Rolling to left		
3. Lying to sitting		
4. Bridging		
5. Bend to touch floor (shoes, socks, etc)		
6. Transfer from bed to chair		
7. Transfer from bed to commode/toilet		
8. Up from floor		
9. Sitting to standing		
10. Walking		
Aids:		
11. Distance walked		
12. Stairs		
Aids:		
13. Driving		
14. Housework		
15. Employment		
16. Shopping		
17. Other problems		

Grading system

1 = Maximum help required
2 = Help of one person required
3 = Independent using an aid
4 = Independent

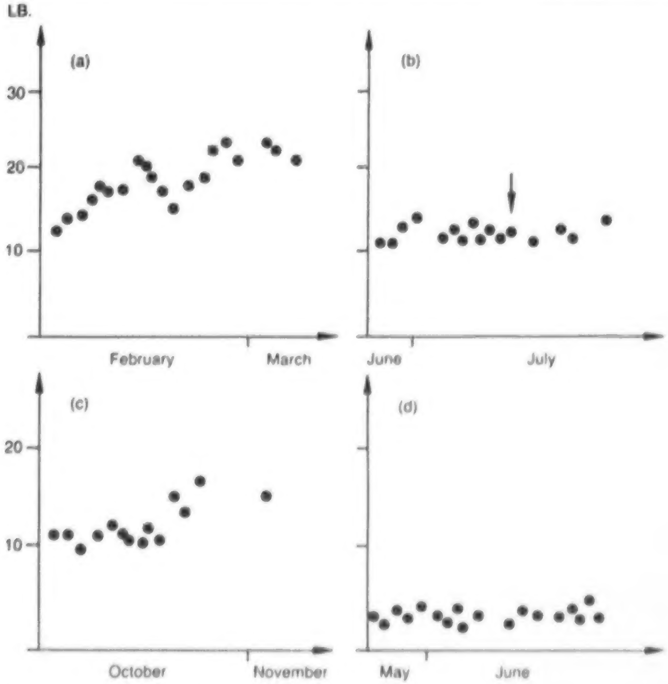

Figure 2: *Isometric exercise results in MND patients (Lenman, 1959)*

We therefore tailor exercise programmes to meet individual patient's needs, but all these programmes have basic aims in common. These are:

(1) To maintain joint range of movement.
(2) To prevent shortening of muscle and other soft tissue.
(3) To maintain muscle power in unaffected muscle.
(4) To prevent disuse atrophy.

Both patient and carer are instructed in these programmes. Where possible, exercise is active, but active-assisted and passive exercise is taught and incorporated into the programmes, where necessary. Home visits, and community physiotherapy are frequently used to assess the patients' ability to continue to cope with their disability.

4. Posture correction: Advice on posture correction is given early, especially to those patients with bulbar and upper limb involvement, as these patients frequently adopt a flexed position which decreases their already compromised respiration.

5. Coping with falling: As fear of falling can be a major barrier to mobility, patients are given instruction in how to fall as safely as possible, in the hope of minimising injury, and the patient is given instruction in how to rise from the floor in the safest manner, with or without the aid of the carer.

6. Lifting and handling: Again instruction is given to patients and their carers or nursing staff in correct lifting and handling. Shoulder trauma and neck support are two important areas to consider. Assessment for more complex handling aids such as hoists, is carried out jointly with the occupational therapists.

7. Respiratory care: Respiratory disability may occur at an early stage, before muscle atrophy is evident, and our patients are given routine instruction in diaphragmatic and lateral costal breathing as well as assisted coughing. Advice on positions to counteract or reduce dyspnoea are also given, as is advice on coping with choking. There is considerable liaison with the speech therapist where bulbar involvement occurs, to obtain optimal breath control for speech and swallowing. In the later stages of the disease, chest physiotherapy is aimed at reducing the discomfort and distress resulting from the accumulation of secretions. Gentle deep breathing with maximum expiration to obtain maximal inspiration are encouraged, with assisted coughing. Oral suction can greatly improve comfort by removing secretions from the mouth and throat, but vigorous postural drainage and nasopharangeal or endotracheal suction are not well tolerated and often lead to excessive tiredness and a decrease in respiratory excursion. It is essential to instruct the nursing staff in these simple techniques to be carried out frequently, for short periods.

8. Mobility aids: In a disease which is often rapidly progressive, the needs of the patient may vary greatly over a short period, so that accurate assessment for, and speedy provision of, the aid is essential. Apart from walking sticks, the most frequently used aids are walking frames, mobilators, and delta mobilators. The latter is particularly useful as it allows a variable width and has a tight turning circle, useful in confined areas such as the bathroom. We are fortunate in having the wheelchair assessment centre at our hospital, and the staff there co-operate closely with the physiotherapist and occupational therapist in ensuring rapid provision of appropriate wheelchairs and accessories.

9. Other aids: Thermoplastic collars in patients with bulbar involvement may be useful. The anterior segment is cut away for easier swallowing, but even this may be too restrictive for certain patients. We have also found a harness, similar to that used by children, of use, especially when descending stairs. The use of pillows and cushions filled with polystyrene beads or foam pieces are particularly useful in achieving comfortable positioning in bed or chair. Ankle foot orthoses with elongated toe pieces and accommodating shoes are very useful to preserve mobility in patients with lower limb involvement.

In conclusion, the physiotherapist working with motor neurone disease patients must work as part of a team. In some areas, she may direct the team, for example in the area of mobility aids, but in others she must work with and learn from other team members. Regular team meetings and reassessment of these patients are essential, and the patients' needs must be, if possible, anticipated, and appropriate aids, teaching, and advice issued promptly.

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Planning a community survey of the younger chronic sick and disabled living in Lothian Region

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1. Introduction

Planning for the provision of appropriate and adequate services for disabled people requires information about the number of people involved, the nature and extent of their disabilities, the help and services they require, and the help and services they already receive.

A Lothian Health Board working party in 1978 noted:

(1) That there was a lack of local information about chronic sick or disabled in the 16–64 year age group.

(2) That the prevalence figures from the National Survey (Harris, 1971) indicated that there would be about 600 severely disabled people in this age group living in Lothian.

(3) There was no information on the adequacy of provision for these people.

It also became obvious that not all was well with disabled people living in the community. A survey of the younger chronic sick and disabled in hospital in Lothian (McAndrew, 1984) found that admission to hospital was frequently due to a breakdown in family and community support rather than a deterioration in the condition of the patient.

Lothian Region covers 700 square miles of South East Scotland. Although one of the smaller Scottish regions, it is one of the most densely populated, with about one sixth of the total population of Scotland. More than half of the population of 730 000 live in the city of Edinburgh.

The information required was not readily available from any source, so it was decided that a survey should be done to identify physically disabled people in the 16–64 year age group.

2. Choice of methodology

There were two feasible ways of identifying disabled people in this age group: a survey of agencies dealing with the chronically sick and disabled, or a survey of households. The latter method was chosen because of the findings of the Canterbury Surveys (Warren, 1975), in which Professor Warren compared the two methods and found that whilst neither method identified everyone with disability, the household survey was more effective.

It was, however, felt that it would cost too much to approach all 261 000 houses in Lothian. Earlier studies (Lowther, 1973; Harris, 1971; Warren, 1974) had indicated that we were trying to identify between 3 and 7 per cent of the population. A statistician was consulted and it was suggested that a 1 in 40 random sample of households should yield accurate information at a much lower cost. It was decided that it would also be cost-effective to do the survey by mail. A review of health surveys (Cartwright, 1983) suggested that an 80–85 % response could be expected for a health-related postal survey in the United Kingdom.

There was a slight problem in sampling, as it was known that in some places younger disabled people are clustered together in supported accommodation, which ranges from residential homes to purpose-built wheelchair housing with or without the services of a warden. These "clusters" of disabled people could affect the statistics, so it was decided to exclude them from the main survey and treat them separately. With help from the Regional Council, a computer-based sampling frame was found. A simple, one-page questionnaire was sent to every household in supported accommodation for the younger disabled, and a random sample of 1 in 40 households in other accommodation (excluding hospitals). A reminder was sent to all those who had not replied after 4 weeks, and again after 9 weeks.

3. Response

The form was completed and returned by 90 per cent of households in supported accommodation and 83 per cent of those in other accommodation. There was some concern that disabled people may be more likely to return the questionnaire than non-disabled people, and our sample population may therefore contain an artificially high number of disabled people. However, when the pattern of response was compared between those households which contained a disabled member and those which did not, it was found to be almost exactly the same.

This, and the results of follow-up visits to those who did not respond to an earlier pilot study, lead us to the conclusion that a disabled person is only as likely to complete and return the form as a non-disabled person, and that in this respect our sample is representative.

4. Results

In supported accommodation, we identified 446 people aged between 16 and 64, 205 of whom had some kind of disability or handicap. 42 of these people lived in residential homes. Only one had a purely sensory disorder (blindness).

In other accommodation, 14,917 people of all ages were identified, 657 (4.4 %) of whom had some kind of disability or handicap. There were 196 (1.3 %) with purely sensory disorders, leaving 461 (3.1 %) with other disabilities. The most common complaint was of a health problem which caused difficulties at work or in other daily activities. The most common problem specified was that of mobility. (Table 1)

Table 1: *Types of problems identified (other than sensory disorder)*

	Number of people	% of total sample
Condition causing problems at work or doing housework	304	2.03
Difficulty with mobility	185	1.24
Difficulty in using arms/hands	114	0.76
Difficulty with self care	56	0.38
Amputation	42	0.28
Bedfast or housebound	35	0.23

From these results we can estimate that, within 95 % confidence limits, there are between 20 000 and 25 000 people aged 16–64 in Lothian Region who perceive themselves to have some kind of physical disability other than that caused by purely sensory disorder (2.8–3.4 % of the population to the nearest thousand).

These people are not evenly spread throughout the region, the rate of 36 per thousand in West Lothian being statistically significantly higher than the rates in other areas ($X^2 = 8.692$, $p > 0.05$). The reason for this is not known at present. (Table 2)

Table 2: *Distribution of disabled people (other than those with purely sensory disorder)*

	Number of disabled people per 1,000 population
City of Edinburgh	30
East Lothian	31
Mid Lothian	29
West Lothian	36

5. Conclusion

A postal survey is useful in identifying the chronically sick and disabled in the 16–64 year age group, but it also has its limitations. It will identify over 80 per cent of people with self-perceived impairment or disability and give some idea of the nature of the problem. However, it will not identify people with impairment or disability who do not want to be identified as such. It will also not give an objective or comparative view of the severity of the problem.

6. Future work

More work is required to sort out the practical implications of these figures. Therefore two more stages to this study are planned. The second stage of the study will be a screening interview of all those who claim to be disabled, to check that physical disability is in fact present, and to establish its nature and severity.

The third stage will be a full assessment of the disabled person, looking particularly at what help is needed by him and his family, and the adequacy of the services he is receiving.

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Working Groups (parallel groups)

– Tuesday, 19th November 1985 –

Group 5 a and 5 b:

"Evaluation of teaching methods, programmes and material in special education" and "Behaviour modification and therapy"

Chair: Prof. Dr. Alexander Hulek, Warsaw, Poland

Evaluation in special education: Information for action

S. Hegarty, Slough (United Kingdom)

Methodological issues are discussed in this paper through examples. Two development programmes are outlined, both of which have a significant evaluation component. These provide the basis for raising some considerations for the conduct of evaluation and for analysing what the evaluator's stance in regard of such programmes should be.

1. The examples

The first example is a staff development pack which some colleagues and I devised and produced in 1984 (Bradley et al., 1985). It is intended for use by further education teachers dealing with 16 – 19 year olds with moderate learning difficulties. Many of these teachers would have had no experience of students with learning difficulties, and indeed, because of the nature of the further education system in Britain, a good number would not have received any teacher training.

The pack itself is multi-media, comprising seven written modules, or study units, a three-hour video cassette, a review of relevant computer software, and details on exercises designed to promote professional development. It can be used by individuals working on their own, but it has been designed for optimal use in small groups where staff engage in structured interaction that simultaneously enhances professional development and promotes curriculum development.

Since the pack was launched in January 1985 it has been publicised in various ways. More specifically, there has been a series of ten regional conferences, covering the whole of England and Wales, designed (a) to publicise the pack, and (b) to develop strategies for utilising the pack in the staff development activities of further education colleges in each region. This dissemination and strategy planning phase is the subject of a further study by my colleague Dr. Judy Bradley. As far as evaluation is concerned, it will be evident that there are two sets of questions: (1) Is the dissemination strategy adopted an effective one? and (2) Is the pack itself a useful addition to in-service training?

My second example relates to a curriculum framework we have developed for students with severe learning difficulties, again aged 16–19, in further education colleges (Dee 1985). This was developed in collaboration with staff engaged in teaching such students. It is designed to act as a stimulus to colleges intending to begin work in this area, and as guidelines to those who have started to make provision. It is supported by a set of subprojects developed by individual course teams, which explore particular aspects of the curriculum in detail.

The framework itself is a substantial document comprising an introduction that sets it in context and describes how it was developed, aims and objectives, teaching and learning strategies, resources, course progression, assessment and course evaluation. The framework is now the subject of a further development and implementation phase, where it will be taken up, adapted and implemented by colleges over and above those involved in the initial development.

2. Implications for evaluation

Programmes of the kind outlined raise quite particular problems of evaluation. I would like here to draw attention to three of these.

First, the evaluations required cannot as a rule be conducted within the traditional empirical research paradigm. This can be demonstrated at various levels but comes down essentially to the mismatch between the requirements of traditional methods and the type of information that can be gathered. Consider the use of control groups for example. If we set up an experimental design to evaluate our staff development pack in this way, we would need (a) a group of teachers using the pack, (b) a matched group not using it, and (c) a further matched group engaged in some comparable professional development activity in order to estimate Hawthorne effects. The three groups would need to be matched in particular on their professional background and their commitment to professional development. Given that there is a dearth of staff development material for this group, and that the pack is the only thing of its kind available, that it was widely publicised and enthusiastically taken up, it would have been difficult, if not impossible, to set up control groups in this way.

Secondly, programmes of this kind are part of the real world and share its complexities and confusions, its blurred edges and false starts. Such programmes are rooted in a particular place and time. It will not be possible to manipulate them so that they fit conveniently into a research context. In particular, it may not be possible to reduce the programme to manageable proportions for research purposes or to consider convenient bits of it in isolation. Both of the programmes mentioned above were in fact taken up and used by teachers in a context of doing their job, not so as to permit us to evaluate the programmes or engage in further research on them.

Thirdly, these programmes relate to a context of action and decision-making that does not wait on the research enterprise. Programmes will continue to run, and services will still be delivered, whether or not evaluators and researchers have an input to make. This may mean that interim, tentative findings that come in time to influence policy decisions are far more relevant than well-founded conclusions that arrive too late.

3. The evaluator's response

How as a researcher or evaluator does one respond to this kind of situation? There is an apparently straightforward question: Does this programme work?, and we seem to be unable to answer it, certainly unable to answer it in a way that meets the canons of traditional quantitative methodology.

It must be said first of all that the latter does not mean that one has therefore to eschew rigour. The failure to conform to the requirements of quantitative methodology does not mean that one is necessarily debarred from making valid judgements. There are many routes to objective knowledge of the world. Qualitative research methods have their own logics and sets of rules, which are quite different from the rules of quantitative methods (Hegarty & Evans, 1985). When a given study is being scrutinised for methodological adequacy and rigour, it is essential that the scrutiny be done in terms of the logic and rule requirements of the particular methods being used.

A more direct response is to insist on a change of focus, a switch which at first sight may appear to be evading the question but in fact is addressing rather more useful questions. The change is from a dichotomous evaluative framework to a relatively open-ended analytic stance. Rather than asking, *Does* it work?, one asks, *How* does the programme work?, How do its different components interrelate?, Are they equally robust in different situations?, How is the operation of the programme affected by external factors?, and so on.

In other words, what is required is *understanding* as opposed to simple judgement. The two can never be separated of course – it is a question of emphasis –, but we can see the contrast if we consider legal practice. A court can find somebody guilty, pass judgement on his actions, without necessarily understanding them in the way that a psychiatrist might. The court can say: Yes, he did it!, but not why nor – more importantly – how he and others like him might be prevented from doing it in the future.

What I am suggesting then is that the seemingly straightforward question: Does the programme work? is relatively unimportant in comparison with questions relating understanding how it works. The educator who is trying to decide on a staff development programme or a curriculum framework does not want to be told simply that the framework or programme works; he or she wants detailed information on *how* it works so that the particular local implementation has some possibility of success.

4. Application to example

Let us apply some of this to one of our examples. Regarding the staff development pack, it is clear that there are two distinct sets of evaluation questions, bearing respectively on (a) the dissemination strategy, and (b) the pack itself.

Questions to ask about the dissemination strategy include:

(1) Have individuals in the target group heard of the pack? How did they come to hear of it?

(2) Have they acquired it? If so, on what basis and in what institutional context? (Is it the case, for example, that a single pack is being expected to provide the basis for staff development activities for 25 staff?)

(3) What understanding do people have of the pack and how to use it?

(4) How is the pack being used? How do the ways it is being used relate to our expectations for it? What are the reasons for any changes in the mode of use?

These questions are in fact shading over into questions about the pack itself. If we consider the evaluation of any staff development activity, the ultimate criterion of effectiveness must be how the people involved do their jobs subsequently, which in this case means the stimulation and management of student learning. Our resources do not permit us to ask these ultimate questions in any detail, and we have to operate at one remove from them. This entails asking questions about the changes brought about in teachers, and on the assumption that certain teacher behaviour is associated with certain desired student outcome. It is convenient to break these questions down in terms of:

attitudes to

- young people with learning difficulties
- teaching them
- engaging in sustained curriculum development

knowledge of

- the nature of learning difficulties

- different curricular approaches

skills of

- motivating
- assessing students progress
- teaching and modifying the curriculum
- working in a team

5. References

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Study of integration strategies

M. Bauer, Paris (France)

Although the feasibility of integration policy can no longer be open to dispute, the diversity of the practices described, the random character of certain experiments, and the lack of identified or identifyable bases for many projects or programmes reveal a critical need to seek criteria which can guide all those planners or decision-makers who must design projects or who must choose these projects. There is a general consensus on the need to draw up a balance-sheet.

For some it would be necessary to assess the real benefits which the handicapped child can expect from a given system of integration into the normal school: total integration?, partial integration?, part-time system?, individual integration?, collective integration?, therapeutic assistance integrated into the education structure?, the continuance of a network of therapeutic assistance independent but in collaboration with the school? Such an evaluative approach would legitimize innovative projects, which are always threatened by their peripheral role compared with more general practices. For the supervisory authorities, this process would doubtlessly provide the means to identify guideline models on the basis of which it would then be possible to legislate.

For others, the objective is broader: the empirical and numerous innovations in educational integration witnessed in various countries constitute a pool of material on spontaneous experimentations, which science should henceforth examine to draw meaning. Through a greater knowledge of the aims and the contents of integration, it will doubtlessly be possible to reach a perspective more in terms of reliable factors than in terms of models. Only the thorough study of the integration process in progress will enable the relevant data to be identified with which to answer the fundamental question of: *what integration for what future?*

As a new phenomenon in our social structure, integration certainly has some strange disarming virtues: already it is undermining the somewhat established conventions of the school and is stirring the moral conscience of normal and specialized teaching.

It is also undermining the conventions of education and health researchers. Not exclusively part of a specific field, necessitating new social attitudes, the phenomenon of integration seems to be poorly conceptualized. Research must be encouraged, the literature on the subject of integration is for ever repeating this necessity. But how can we conduct relevant research? Must such research be based firstly on synthetic evaluation or on analytical methods?

For the moment, international literature remains meager particularly as regards relatively exhaustive studies, except economic assessment studies such as those listed by Karl-Gustaf Stukat in 1983 (1), or surveys into "pedagogical technology" such as those listed by Rudolf Schindele in 1983 (2), and the descriptive assessments of the OECD for some countries (3); there are few duely listed scientific publications devoted to the study of longterm collective projects in educational integration.

In Sweden, educational authorities have managed to collate and compare existing research studies during a congress held in 1982 (4). Their conclusions frequently lead to the assertion that from now on, to advance not always satisfactory integration practices, it is necessary to initiate genuine research on the subject which preceeds the practical projects.

Other countries, like Canada where integration has developed rapidly through the introduction of experimental programmes (5), must realize that assessment studies which were to follow have not been collated and published. We can only regret this omission.

In France, a critical review published in December 1982 by the National Institute of Teaching Research (6), devoted to the sciences of education through works over the last 15 years, contains not a single chapter on integration, nor do the other headings include studies devoted to the educational integration of handicapped children.

When I refer to the analysis of French professional literature on the subject of integration, which has been plentiful since 1975 and superabundant since 1980-81, I note that while evaluation is held to be desirable, professionals in the specialized as well as the ordinary schools sector take great care not to commit themselves. This imposing mass of articles, reports of meetings and study groups is mainly devoted to generalizations, which legitimize integration, or which reiterate preliminary notions now accepted by everyone as being necessary to integrating difficult children into the school system. Reports on integration cases are actually increasing in numbers, but projects are presented in strictly descriptive form; they deal with integration from the viewpoint of mutual tolerance between the handicapped child and the class, the teacher and the school. Most of these descriptions only concern successful cases.

It is regrettable that this literature does not contain:

- sufficient critical studies of reported projects,
- genuine assessment studies,
- basic texts devoted to the redefinition of the objectives of the school,
- arguments or theoretical discussions on possible specialized teaching methods to be introduced.

Given this lack of scientific material and the marked reticence of the professionals to apply, or to permit application of, rigorous evaluation processes in their integration practices in teaching children with different needs, the question must be asked what it is that induces various individuals not to implement a desire so strongly expressed in the discussions.

As long as we talk of assement without further conceptual explanations, or without information as to the process, we will doubtlessly arouse great fear in some of being judged on their actions, i. e. on their professional identity, or simply on their identity, and in others the feeling of impotence in the face of the difficulty of "finding sufficiently competent evaluators (it is in fact necessary to fully grasp the subject of evaluation), true sentiments, models and criteria", as Daniel Stufflebeam (7) puts it. He states that evaluation in education may be deemed to be seriously unsound when it shows symptoms of escape, anxiety, inertia, scepticism, and the absence of motivation, symptoms which are especially noticeable in those who claim to be interested in the balance-sheet of educational integration.

To propose *the studiy of integration strategies* instead of constantly repeating the need to launch evaluation processes is not a strategy to avoid the introduction of an anxiety-arousing concept, but a working assumption with which to choose a practicable methodology.

If we agree with Stufflebeam that the traditional evaluation processes on the whole correspond to the three types mentioned above, it is clear that the best known and most common evaluation methods are not the best adapted to the study of integration.

– 1st model

The purpose of evaluation is to measure results, since it is based on objective techniques and yields quantifyable data. However, its aim is to produce a *judgement on the merit of the actor or on the value of the action taken.* The criteria used are often determined according to subjective or ideological considerations.

Many educational research studies are of this type. It would be a pity to advocate this model for the study of integration because it is feared by professionals. The judgement made on their work in the handling of a handicapped child may in this case be based on criteria arbitrarily selected from the objectives they have followed. The economic research studies reviewed by Stukat in "Economic Aspects of Special Education" (UNESCO publication) partly meets this definition, but, as the author remarks, to evaluate educational integration it would first be necessary to be extremely clear on objectives or at least on priority objectives, since integration into the school system is not synonymous with well-meaning tolerance or with assimilation.

– The 2nd model is known as congruence research evaluation

The second type of evaluation aims at determining congruence between the performance of the subject, or the productivity of the process launched, and the objectives. For the study of integration projects, this evaluation model should provide the means to determine for completed or current projects' suitability of programmes or solutions chosen with short-term, medium-term or long-term objectives chosen for a given child or for specific groups of children. This evaluation may however fail to supply data on the strategies previously identified as assisting the implementation of preset objectives. Part of the subsidiary gains from the integration process may escape examination, and certain options may not be identified.

Our understanding of the strategies used may therefore be hampered, and our knowledge of indicators to achieve integration may contain loopholes.

– The 3rd model is the professional judgement evaluation or estimation by an expert, called an audit in current terminology

This evaluation practice is conducted on a set of data supplied by the authors themselves and is based on a judgement and interpretation of this synthesis previously worked out by the authors themselves. OECD evaluation studies seem to be in line with this perspective. Offering a significant synthetic approach, this method however seems debatable, since the criteria applied to obtain data and the method to collate data may depend on the ideology of the evaluators and on their requirements of thoroughness or exhaustibility.

Yet the care of a handicapped child is highly complex: it almost invariably requires multidisciplinary approach. The programme designed for the child must adequately meet the needs of a developing individual, prepare his future independent integration in the outside world and include the necessities of giving assistance to a young person affected by some handicap or disorder. Integration into the ordinary school implies observance of all these objectives, which necessitates a school structure as flexible and adaptive as possible and able to fulfill its role as a place of socialization. The correct measures are not always easy to find since they are not verifiable. Of course, this policy of the host school, which varies according to each child, relies on constants, which constitute to some extent the underlying principles which should now make it possible to objectively examine the many cases of integration in the various countries.

This kind of research is extremely difficult because it requires an analysis and assessment of a series of components in the light of the data. However, there are two ways to evaluate these components which most of the time depend on different disciplines and technologies. One way is to examine each component in order to determine whether or not it is compulsory, in other words to verify if its elimination will entail less acceptable or different results. The other way is to study directly the combination of components, since it is recognized in this sector particularly, that the interaction between elements yields a result superior or inferior to the sum of their respective contributions.

We are therefore led to assume that there is probably a need to identify the combinations, which we might also call projects, long-term programmes or strategy, these being "the art of preparing a *plan* of campaign*, to attack the decisive or strategic points and to recognize the points on which during the battles the majority of troupes must be assigned to ensure victory" (Littré).

Thus we accept the process of integration as a complex arising from the interactions of a series of parameters of different kinds and values. We recognize that the total synthetic evaluation of the third type is as unsatisfactory as the experimental verification of specific variables which are artificially isolated from the whole. We admit our ignorance of relevant interactions as regards the purpose of educational integration, which is the best educational integration possible for the adult handicapped, in other words a flourishing life, as independent as possible, integration into the world of work, leisure activities and community life. Hitherto we have probably given insufficient attention to seeking and publicizing the ways of achieving educational integrations. In this context we obviously think of public expenditure which can no longer afford wastage, regardless of the country concerned.

But we should also draw attention to the right of teachers not to be overworked or left alone to carry out the integration of one or several severely handicapped children beyond their psycho-physiological natural resources.

This wide range of factors is not sufficiently well identified so far. This should perhaps be the first objective to be set in research studies. Since to analyse means "to break down a work into its *essential* elements, to grasp the relationships and to provide an overall plan" (Petit Robert), or since logic is "the method whereby effects are traced to causes and consequences to principles, from the particular to the general or from the compound to the simple" (Littré), perhaps it would be necessary to call on practitioners themselves to perform this exercise on projects which they themselves have empirically introduced. The method of systemic analysis applied to strategies already in more or less general use and to exemplary innovations could also assist in achieving this decoding. In an initial phase, this study should be conducted in various countries or regions with different socio-political contexts. An international study might later be launched to work out the synthesis and comparisons necessary to establish significant criteria or indicators whose value could be directly categorized and result in a classification of the following type:

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* All educational integration must at present and as far as we know be conducted as a military campaign; i. e. rigorously, with a view to obtaining final victory which can only be assessed in terms of the capacity of social integration at adult age.

- to be observed at all costs when preparing a system of integrating handicapped children into school,
- to be considered in a given circumstance,
- to be declared not decisive but likely to modify the process,
- non-influential factors.

The identification of influential factors could thus be rendered possible for all partners concerned with integration, i. e. family, medical and social workers, teachers, the general public (here comprising other children and their families). It could perhaps inform individuals on the major psycho-social barriers inhibiting the potential extension and spread of integration of all handicapped children into ordinary schools. Such identification could also counter fears of evaluation, which is frequently perceived as a judgement passed from some external source on "what have I done or not done?".

Being an important but not exclusive element may ease the share of responsibility, and hence lighten the guilt felt in various degrees by all those who work with slow growth children. The professionals would probably more readily participate in the evaluation if researchers first informed them of the objectives and later involved them gradually in their studies. Everyone might then be asked to comply with the principles of projects and with the clinical transfer of their psycho-educational relations. In this way, the fear of professionals to provide written records could be overcome, and the paralyzing vacuum that research has been experiencing in France for the last fifteen years could be brought to an end.

We could then hope for reconciliation of professionals with evaluation, which would become "the process whereby is framed, obtained and supplied useful information with which to appraise possible decisions".

We therefore recommend a research-action process comprising two distinct but closely linked phases, since each phase generates a new stage: *possible integration* will be elaborated on a day-to-day basis according to the creativity of the actors, but based on new knowledge revealed by research, *desirable integration* will emerge after filtering, analysis and verification as regards the degree of possible application of correlations of isolated data and of processing of theroretical explanations.

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Emotional upset after myocardial infarction – How should it be conceptualised and measured?

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Several studies have now shown that psychological and social as well as organic factors are relevant to a patient's recovery from a myocardial infarction (2, 8, 9, 17). These studies concur in demonstrating that emotional upset inhibits rehabilitation and recovery in its widest sense. However, the term "emotional upset" is a global one, which has been measured in diverse ways including direct examination of patients by a psychiatrist, analysis of nursing reports and casenotes, patient self-report in both unstructured and questionnaire form.

Two main classes of questionnaire or inventory can be distinguished. The first comprises measures, developed within general psychology, whose content and underlying theory are concerned with the full range of normal emotional response, especially anxiety. In Edinburgh, we have made extensive use of Cattell's anxiety scales to assess patients in the Coronary Care Unit, in the hospital ward and at out-patient follow-up (1, 14, 15, 18). Although clearly at the trait end of the trait-state continuum, these scales do measure general anxiety in a reliable, valid manner. Table 1 compares the mean anxiety scores of coronary care patients with those of other groups of Edinburgh patients. Patients tested in the Coronary Care Unit were no more anxious than non-cardiac emergency admissions or patients admitted for gastro-intestinal surgery (13, 18). In all three groups, the mean score is very close to that of normal subjects, which is in stark contrast to the means for patients assessed soon after admission for treatment of acute self-poisoning and for a series of acute admissions to a psychiatric hospital (11). Using Eysenck's Neuroticism Scale (3) as a measure of upset, Naismith et al. (9) also found myocardial infarction patients to be no more upset, as a group, than normals.

Table 1: *Anxiety in coronary and other patients*

Patients in:	*Mean anxiety*
Coronary Care Unit, n = 338	5.6
Acute medical ward, n = 30	5.8
Acute surgical ward, n = 68	5.7
Acute psychiatric wards, n = 306	7.1
Acute self-poisoning ward, n = 180	7.9
(Scottish normals, n = 284)	(5.4)

The second main class of questionnaires are those which are psychopathological in content and purpose. These measures are concerned with the identification of morbid mental states, some of which can be considered to be exaggerated forms of normal moods, while others are either extremely rare in the population at large or are qualitatively distinct from normal experience. On such measure is Foulds' Personal Disturbance Scale (4), which, using a cutting point which classifies less then 1 % of normals as "disturbed", classifies 37 % of infarction patients and 44 per cent of those awaiting gastric surgery. A psychiatrist who interviewed all these patients found that some degree of emotional disturbance could be identified in 60 % of each group (2, 13).

Although Cattell's anxiety and the personal disturbance scale correlate significantly (r = 0.58) (10), the results obtained on this cohort of infarction patients could, if used selectively, lead to quite different conclusions about "emotional upset" in such patients. In turn this could lead to completely different styles of rehabilitation as well as utter confusion in comparing the work of different centres.

The findings now reported are based on a study of 275 patients with coronary heart disease (12). This paper considers the relationship between three measures of emotional upset: a structured psychiatric interview devised by Goldberg et al. to detect minor psychiatric morbidity (6); a questionnaire designed to detect current psychiatric disturbance, Goldberg's General Health Questionnaire (GHQ) (6); and measures of general anxiety, Forms A and B of the Eight Parallel Form Battery (16). General anxiety was assessed within 24 hours of transfer from the Coronary Care Unit to a general ward and again on the day before discharge from hospital some 14 days later, while the Structured Interview and GHQ were administered at the end of the first week in the ward.

The findings for these measures on this group of patients replicate very closely the results found on the earlier cohort. Cattell anxiety is elevated (6.5sten) on transfer from the Coronary Care Unit but returns to just below the normal mean by the time of discharge. The GHQ, like the Personal Disturbance Scale, identifies 37 % of the group as probably suffering from minor psychiatric disorder. The results of the Structured Interview are shown in some detail in Table 2. Patients falling in the grades Mild, Moderate or Marked are considered to be "cases"; using this criterion, 50 % of the present group are deemed to be cases, compared with 20 % of unselected patients seen in general practice.

Table 2: *Structured Interview (Ward) - Severity of Disturbance*

Grade	*Per cent (n = 273)*
Normal	16.8
Subclinical	33.0
Mild	20.5
Moderate	28.6
Marked	1.1

Table 3 shows how these diverse measures of emotional upset are associated. The correlations are statistically significant, but modest in size, indicating that the measures are tapping different aspects of emotionality. This confirms the earlier finding that general anxiety as a measure and construct used by psychologists is far from being synonymous with emotional disorder as conceived and measured by psychiatrists. Table 3 also shows that the Structured Interview and the GHQ, both measures of psychiatric morbidity, correlate rather indifferently. This is amplified in Table 4 which shows the extent to which the Strctured Interview and the GHQ agree on defining "cases". In this group of physically ill patients, the GHQ is more conservative in defining cases than is the Structured Interview.

Using the Structured Interview as the criterion measure, as it was in Goldberg's original validation study, Table 5 indicates that the GHQ is a modestly sensitive but quite specific predictor of caseness; almost all patients classed as cases by the GHQ are classed as cases by the interview, but almost half of those classed as GHQ-normals are rated as disturbed by a psychiatric interviewer.

Table 6 extends this theme to the Cattell measures. Patients scoring eight or more on the anxiety measures, are highly likely to be rated disturbed on interview. However, patients with lower anxiety scores are not necessarily symptom-free, emphasising the earlier point that measures of general anxiety are not very sensitive to clinically significant mood states.

Table 3: *Correlations between measures of emotional upset.*
(All correlations statistically significant.)

	1	*2*	*3*	*4*	*5*
Interview (1)	–	.54	.45	.33	.20
GHQ score (2)		–	.83	.37	.34
GHQ case (3)			–	.31	.24
Cattell A (4)					.54
Cattell B (5)					–

Table 4: *Structured Interview (Ward) and GHQ caseness.*
(Misclassification [.20] = 24 %)

		GHQ		
		Normal	Case (12+)	
	Normal	96	22	118
Structured Interview				
	Case (2+)	53	64	117
		149	86	235

Table 5: *Predictive Value of GHQ in ward*

Ward (n = 215)	
Sensitivity	55 %
Specificity	81 %
Misclassification (.20)	24 %

Table 6: *Structured Interview (Ward) and Cattell caseness*

	Cattell A		*Cattell B*		
	7/8	*8/9*	*7/8*	*8/9*	
Sensitivity	49	29	16	6	%
Specificity	74	83	92	99	%
Misclassification (.20)	31	28	24	20	%

The Structured Interview is composed of two main elements: symptoms volunteered by or readily elicited from the patient, and signs of manifest abnormality observed by the interviewer. The most common symptoms in the present group are sleep disturbance and fatigue, present to a marked or moderate degree in 30 % of cases, followed by irritability which presented in 24 % of the group. Moderate or marked anxiety or depression were less common, being declared in 16 and 13 % respectively. The psychiatrist interviewer identified marked or moderate anxiety in 21 % and depression in 11 % of cases.

These responses to individual signs and symptoms of emotional upset are the most specific indicators of psychopathology available for this group of patients. As a final test of the separateness of measures of morbid upset from those of general anxiety, a set of multiple regressions was performed to assess the extent to which the scores or gradings on the Structured Interview, GHQ and Cattell scales could be predicted from individual signs and symptoms elicited during the interview. The values presented in Table 7 are based on stepwise regressions terminated at the step when each item in the regression yielded a significant F ratio, The gradings of the Structured Interview are predicted very accurately by seven signs and symptoms, indeed, using ratings of observed anxiety and depression alone yields a multiple correlation of 0.92. Both GHQ score and GHQ caseness (i. e., scores reduced to a dichotomy) are predicted by symptoms elicited from the patients rather than by signs rated by the psychiatrist. The multiple correlations between symptoms and signs and Cattell anxiety reached statistical significance but are of limited practical value.

These results confirm earlier findings and add further to our knowledge of "emotional upset" in patients who have suffered a myocardial infarction. Regarding their psychiatric state, these patients complain mainly of sleep disturbance, fatigue and irritability, unexceptional in a patient group such as this but hardly central to the concept of anxiety. Final

Table 7: *Predicting test scores from symptoms and signs.*
(Regression based on significant items only, n = 175)

	R	R^2	*Items*
Structured Interview	.94	.89	7
GHQ Score	.75	.57	7
GHQ case	.59	.35	4
Cattell A	.34	.11	2
Cattell B	.33	.11	2

grading on the Structured Interview depends greatly on the interviewer's rating of signs of abnormality, with symptoms elicited from the patient given less weight. The agreement between the Interview and the GHQ in this group of patients is lower than that reported in a general practice sample (6), and this may be due to a lower level of reporting of symptoms of anxiety in the present group. These patients express less anxiety than is observed by a trained psychiatrist and highlight the difficulties inherent in conceptualising and measuring "minor psychiatric morbidity". The General Health Questionnaire is a popular, widely used measure, not only of distress but also "caseness". On the present evidence it measures aspects of depression as much as anxiety, relates less well to the Structured Interview than it did in Goldberg's early work and, when reduced to a dichotomy, can produce somewhat different correlations with other variables.

The Cattell anxiety scales are clearly not very sensitive to mood states on the borderline of the pathological, although they can reflect upset such as that experienced on leaving the Coronary Care Unit. Trait or dispositional measures such as Cattell's anxiety or Eysenck's neuroticism, although not sensitive to short term mood, have considerable value in predicting outcome in patients of the kind described here.

Expert appraisal of mental state, self-report of current mood state, and trait measures of anxiety or neuroticism all contribute to describing "emotional upset". All three seem to be required to cover the construct adequately. It is difficult to compare studies from centres having different cultural, social and economic characteristics. Such comparisons become almost impossible if the results and conclusions of such studies are based on measures that are only approximately similar.

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Behavior modification and therapy in rehabilitation

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1. Introduction

In the light of more recent thinking, it has been acknowledged that psychological processes are very important as aggravating side-reactions to disabilities as well as to learning to deal with them. This recognition was already accommodated in the USA during the 50s with the introduction of an APA Division for Rehabilitation Psychology. Comparing the rehabilitation practices of various schools of psychotherapy, the psychoanalytically oriented therapy emphasized the treatment of neurotic middle class patients. In the 60s, behavioral therapeutic measures began to develop, and according to Hersen et al. (1983) markedly improved the quality of life of developmentally and/or physically disabled persons. Rehabilitation psychology in Europe has emerged much more hesitatingly. In West Germany it was accorded a professorship only in 1979. The behavioral therapy procedures have also increased their influence in the area of rehabilitation in Germany during the past 10 years only. Physicians' demands for speedy and efficient change in behavior and for clarity, high practicability, and ability to control effects have certainly played a decisive supporting role, and in the past years have encouraged the development of a behavioral medicine.

The present study's aim is to provide an overview of the expansion of behavioral therapeutic practice in rehabilitation, of the therapy's goals for various types of disabilities, of therapeutic procedures, the assessment of therapeutic effects, and a discussion on the type and necessity of evaluating psychotherapeutic strategies in the area of rehabilitation.

2. The behavior therapy approach

The basis of behavioral therapy is the assumption, taken from the theory of learning, that behavioral problems of disabled persons have been learned, that they can be elicited by a preceding event, channelled by consequences and that they can be unlearned again. Learning theory explains the emergence of behavioral problems either according to the model of classical conditioning (linking an unconditioned with a conditioned stimulus) or to the operant model (controlling behavior through positive or negative consequences). Accordingly, a new, alternative behavior can be shaped in the course of therapy. (For principles of behavior therapy and techniques see Rim & Masters, 1974; Kanfer & Goldstein, 1980; Revenstorf, 1982; Lutzker et al., 1983). Behavior modification and therapy do not focus exclusively on observable behavior. With the ascendancy of the so-called cognitive behavioral therapy, they focus also on internal factors such as attitude and opinion. Most of the customary guidelines for behavior therapy are also incorporated in rehabilitation: the shaping of new or alternative behavior through reinforcement (i. e. social reinforcement or so-called tokens); eliminating behavioral problems; practising new social behavior through social skill training; the acquisition of self-control techniques; and the reduction of fears through systematic desensitization. Bio-feedback therapy is also closely tied to behavioral therapy. Its goal is achieving relaxation and finding possibilities of correcting unwanted behaviors through feedback of physiological function.

Behavioral therapy begins with extensive behavior analysis, which records the behavior problems at hand, their antecedents and consequences. Ideally, the client analysis is complemented by an environmental analysis. In principle, behavior analysis is being continued throughout the therapy, and can thus lead to further therapeutic goals and methods.

Therapeutic goals in principle are defined through an agreement between therapist and patient, and a therapy contract is made. It should be stressed that mediators (i. e. parents, medical staff) play an importent role in the application of behavior techniques for several reasons (see Tharp & Wetzel, 1969; O'Dell, 1985):

- Persons in the natural environment have been in contact with the patient for a long time, i. e. parents of handicapped children or medical staff;
- these people have already established stable relationships with the patient and thus provide an important resource for the therapeutic process (provided they are motivated to support the therapeutic goals);
- they allow for control of reinforcers and thus increase efficiency of behavioral therapy;
- participating in the therapeutic process might also encourage these persons and help fight resignation and feelings of helplessness. But because of their important role with respect to the feasibility and efficiency of behavior therapy in many cases, it should be stressed that these mediators often do need professional counselling, training and supervision to avoid unfavorable interactional problems between them and the patient.

3. Examples of application of behavior therapy in rehabilitation

In order to provide an initial impression of the breadth of applications possible within the field of rehabilitation, an overview of the typical areas in wich behavioral therapy methods are put into practice should be given first (see Table 1). It shows that the range of applications includes most of the areas of rehabilitation, and that mentally as well as physically disabled persons and patients of all ages are treated. Therapeutic goals show a wide range from everyday practical skills (such as washing, shopping, cooking etc.) to special techniques for language training or building competent social behavior.

Successful outcome through application of behavior therapeutic techniques have been reported for instance in the treatment of various mental disabilities; of physical handicaps stemming from sensory, neurological, motor, and other organic disabilities; and also in the treatment of psychosomatic illnesses, and of the impact and compliance problems of many chronic diseases. These positive results, however, are based on greatly differing success criteria and evaluative approaches so that they do not lend themselves to comparison or assessment of the effectiveness of behavior therapy methods in the various fields of rehabilitation. This problem will be dealt with in more detail in the following. All in all, Cuvo and Davis (1983) find progress through behavior therapy to have been greatest in the treatment of mental retardation. Behavior therapy appears to them to be "the treatment of

Table 1: *Behavior therapy in rehabilitation – recent reviews of some areas of application*

1. *Speech impediments, language deficits:* Lovaas (1977), Kent-Udolf (1983), Keogh & Whitman (1983), Goetz et al. (1983)
2. *Autism:* Lovaas (1977), Romancyk et al. (1983)
3. *Hyperactivity and attention deficiencies:* Ayllon & Milan (1983), Rapport (1983)
4. *Neuromuscular disorders, neurological impairments:* (Basmajian, 1983):
    - neuromuscular diseases (Martin, 1976, 1983)
    - neurological impairments (Melin et al., 1983)
    - Stroke (Basmajian, 1980, 1982; Martin, 1986)
    - bladder incontinence (Lutzker et al., 1981), fecal incontinence (Engel, 1982)
5. *Mental retardation:*
    - in children (Keogh & Whitman, 1983)
    - in adults (Repp & Burton, 1983)
    - in all ages (Shapiro, 1981)
6. *Learning disabilities:* Gadow et al. (1983)
7. *Psychiatric illness:* Hersen & Bellak (1978), Matson (1980), Lutzker et al. (1981)
8. *Alcoholism and drug abuse:* Marlatt & Nathan (1983), Stitzer et al. (1983)
9. *Chronic illness,* e. g.:
    - changes in type-A behavior or cardiac infarction patients (ROSKIES, 1982)
    - acquisition of self-control for mastering of compliance problems in hemodialysis treatment (Muthny, 1984)
    - coping with cancer and its impacts (Wellisch, 1981)
    - hypertension (Taylor, 1980)
    - behavioral medicine with chronically ill children (Parker & Cinciripini, 1984; Hobbs et al., 1984)
10. *Chronic pain:* Fordyce (1976), Williamson (1981), Larbig (1982)
11. *Visual Impairment:* Van Hasselt (1983)
12. *Eating disorders:* (Galler, 1984);
    - obesity (Stunkard, 1978; Foreyt & Kondo, 1985)
    - bulimia (Pope & Hudson, 1984)
    - anorexia (Ferguson, 1981)
13. *Geriatric problems:* Patterson & Jackson (1980), Hussian (1984)

choice for severely and profoundly retarded individuals". Another especially important contribution of behavior therapy they mention is the treatment of autistic children.

Using biofeedback therapy as an example, the possibilities of behavioral therapeutic intervention will be demonstrated, but at the same time the limitation on judging its therapeutic efficiency will be pointed out.

Biofeedback is a technique by which psychophysiological functions (i. e. muscle activity, cerebral activity, bio-electric activity of the skin) are reported back to the patient by way of the respective instruments, in order to attain a (therapeutically) desirable control of physiological functions. Studies conducted especially in the USA in the past two decades on the application of biofeedback in therapy, have provided fundamental evidence supporting the efficacy of this technique also in the field of rehabilitation. Especially the feedback from surface EMGs has become an established component of the treatment of neuromuscular disorders in America. Thus far, the treatment of flaccid and spastic pareses following apoplexy has shown the most distinct success (Basmajian, 1983). Several studies have noted enhanced therapeutic results when EMG-biofeedback is applied in addition to the classical methods. Astonishing therapeutic progress was made even in cases where pareses remained resistant to therapy over a number of years.

It is therefore surprising that in spite of the positive experience in America, biofeedback procedures are rarely put into practice in Europe. What is especially lacking is an equivalent European research effort for testing and possibly developing further the more promising approaches toward treating torticollis spasticus with EMG-biofeedback (Brudny, 1982), and epilepsy with EEG-biofeedback (Sterman et al., 1974). Controlled studies with long-term follow-up examinations on the use of biofeedback in rehabilitation are very much needed to determine whether biofeedback should be considered a technical placebo or truly an especially effective method.

4. Evaluation of behavior therapy measures in rehabilitation

Behavior therapy strategies are more often evaluated to objectify effects in rehabilitation than other therapeutic disciplines, but still too infrequently and often employing inadequate methods. According to the review given by Lutzker et al. (1981), "work with clients in need of rehabilitative therapy still includes a large number of noncontrolled case studies." Cuvo & Davis (1983) demand so-called second generation studies beyond the anecdotal evidence of singular effects, and with the goals to: "a) compare the relative effectiveness of two or more strategies, b) explore the parameters of an intervention, c) evaluate the usefulness of components in a treatment package, and d) assess the cost effectiveness of procedures" (p. 382).

The core of evaluating the effects of therapeutic practices should contain not only the discussion of adequate (and as broadly conceptualized as possible) success criteria, but especially questions concerning long-term results and generalizability of the effects.

Evidence of prolonged effectiveness can only be found in longterm catamnestic studies that are designed in such a way as to allow true observation of the course and process. The generalizability of effects, according to learning theory, is a matter of interest in terms of stimulus generalization as well as response generalization. It should be investigated under which conditions the therapy succeeded, and if these conditions can be replicated in typical therapy situations. In other words, it can hardly be expected that the effects of therapy achieved by highly skilled personnel with the assistance of complex, expensive equipment and after a tremendous expense of time, can be transferred for use in the usual rehabilitative practice where large sacrifices have to be made in all three of these essential areas (Cuvo & Davis, 1983).

Finally, it must be mentioned that the significance of behavior therapy for the field of rehabilitation cannot be definitely assessed. Besides promising individual trials and evaluative approaches, there is still a general lack of empirical verification of therapeutic results, especially in West Germany. Such studies should however be urgently carried out in the interest of the disabled in view of improving the criteria for rehabilitation strategy decisions. It would also be desirable if the different therapeutic schools would concentrate their controversies on the concrete and measurable benefit to the patient (and therefore perform evaluation), instead of engaging in polemics over basic positions.

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Social functioning ability

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1. The problem

For some years the aim of rehabilitation has been expressed as "integration and full participation". The problem is how to evaluate these concepts.

A conceptual analysis of "social integration" reveals that one refers to a phenomenon where in the beginning a person or persons are apart from others and at the end what was apart has become a part. What unites the two opposites into an entity? It becomes obvious when we look at the antithesis, i.e. segregation. In the observable world there are discrete entities we *think* belong together and should be one entity. The uniting factor is nothing but an idea, a concept. The verb *should* tells us that action is needed to achieve integration.

A concept can be either *deviding* (segregating, analytic) or *uniting* (integrating, synthetic). In order to see the quality of a concept – to make it visible –, we define it and operationalize it. Social functioning ability is an essential characteristic of integration, and for operationalization – a practical rehabilitative measure – we have developed adjustment training. Both concepts – social functioning ability and adjustment training – are not new, but met each other only recently.

2. Social functioning ability

2.1 "Social" social functioning ability

When Rehabilitation International started to look at social rehabilitation as having an identity of its own (not only an addition to the other rehabilitation fields), it started with the environment. This happened in the year 1972. Social scientists have for a long time considered man part of his or her society. There are minor differences in terms and explanations. The entity has been called different names: class, totality, Gesamtheit, system, second grade social unit, Gestalt. It cannot be researched by quantitative methods but needs qualitative ones. In medicine, epidemiology and some traditional schools come closest to this thinking.

From this point of view, social functioning ability becomes a characteristic of society. The terms used are similar to those of epidemiology, we can speak of rate of unemployment, prevalence of architectural barriers, etc. When social functioning ability is understood as a characteristic of society, rehabilitation measures must be incorporated into policies (politics included). This kind of thinking is advocated by several rehabilitators in view of the increase of unemployment.

2.2 "Individual" social functioning ability

When we think of individual social functioning ability, we think of the abilities of an individual independently of his or her society. Man is thought to be a discrete dualistic entity having a body and a soul. The boundary between the environment and the individual is thought to be obvious (a primitive scientific truth). What happens within the rational body and in the more or less irrational soul are thought to be experiences which happen inside man only. The individual social functioning ability is than interpreted to be a combination of the bodily and the psychic functioning abilities. The concept of the psychomotorical unites the soul with the body.

From the point of view of social sciences, both the "social" and "individual" approaches belong into history.

2.3 Other solutions

Real life observation shows that man is neither fully autonomous, i.e. independent of the environment, nor is man fully depending on it.

In rehabilitation the problem has been solved – according to the WHO suggestion – by the concept of interaction. An individual and the environment are thought to be discrete entities which interact. However, there is no room for freedom, for autonomous actions. Some place the initial action in the individual (environment reacts), some in the environment (the individual reacts). In the WHO proposal the environment reacts. Adjustment training uses another kind of image of reality. Let me explain what happened in the social sciences lately in Finland.

It began some 20 years ago when WHO provided a new definition of health. The concepts connected with health were interpreted by Tapani Purola using the general systems theory. Later, Antti Karisto developed this further in his study of welfare and sickness. He uses the classifications of the (Finnish) welfare research, including the qualitative aspects in the evaluation of how a disease affects the social functioning ability of a person. Aulikki Kananoja and Anni Pentinmäki developed a taxonomy and also a scale. They found that the category of identity had to be included. This finding was supported by the evaluation of social functioning of young coronary patients by Juhani Julkunen. He found that the most important variables were IQ and strength of ego. Physical abilities were far less important.

Antti Eskola and Jorma Sipilä both argue that social functioning is based on action and intention. They say that it may be possible to explain a social phenomenon using the categories of geography, economics and politics, but in order to make an intended intervention the category of consciousness has to be included. I find it surprising that the basic concepts of impairment, disability and handicaps in the WHO proposal have been made using this category, but it is not included in the classifications.

3. Social functioning based on consciousness

3.1 The Tampere definition

An international seminar on social functioning ability held in Tampere developed a definition for it, which works on three levels. The elementary level consists of the normal services of society (medical, economical, social, and cultural). If these do not achieve the aim, we turn to the second level: rehabilitation measures. If integration is not achieved even by these, we use special social rehabilitation measures. We can devise a taxonomy for these measures.

The basic category in the taxonomy deals with the physical world, with senses, observable quantitative quality. A society lives in a geographical place. There are mountains and plains, buildings, streets and roads, water faucets, switches, etc. This category is implied when we speak of "architectural barriers", "housing adaptations", "activities of daily living", or "technical aids". A method has been developed in Finland to survey the physical environment and its accessibility. It is possible that no material intervention enables persons with severe disabilities to cope with the requirements of the physical environment, in which case a personal assistant is required. This happens in cases of severe mental diseases, retardation and with severe physical disabilites. Medical and social practitioners have to deal with this category.

The next categories deal with the functions (changes) of society. The first of these is changing the physical environment: the society produces, distributes, and consumes. There are several terms used depending on the point of view of the classifier: e.g., satisfaction of needs, unemployed, poor. The vocational and social practitioners work in this area. The division of work between the two is usually made by looking at the production (vocational) or at the consumption (social) side.

The third category deals with relations (and changing them) of the members of society. These relations are influenced by parliamentary acts, administrative directives, norms, attitudes, emotions, etc. We speak of outcasts, privileged persons, etc. Psychiatrists and social practitioners work in this area. Therapy (medical) and counseling (social) are the basic forms of rehabilitative intervention.

The fourth category deals with intentions, meanings, the rights and wrongs of culture. This is the category of consciousness. The inclusion of this category is the essence of the modern concept of social functioning ability and adjustment training emphasizes activities in this category. Some ten years ago, Mr. Veikko Niemi, the Finnish Grand Old Man of social rehabilitation, proposed that the courses should be named "consciousness training". This category is often excluded from research projects which are based on the paradigm of natural sciences, but in the art, it is "the art".

3.2 How does consciousness operate?

There is only one method to research consciousness – introspection or reflective thinking. Reflective thinking is the category which makes the difference between man and ape. In Finland, this method is sometimes called „chamber philosophy", but actually it is the most objective method of all – every human being has the necessary resources at his or her disposal, the empirical test can be made anytime, anywhere, and it can be renewed by anybody, etc.

When reflecting on one's consciousness, two elements become noticeable: observation and concepts. We observe and we think. The object of our observation can be a physical thing, a timetable (process), an emotion, a memory, a dream, or even a thought or a thinking process we engaged in earlier.

When we want to think of something, we can to that. Thinking is free of the limits of space and time. Thinking deals with concepts. We can say that in all other aspects of human life, we are bound to our environment, but in thinking we can be free of it. Only I can be the originator of my thinking.

Elementary observations on the workings of human consciousness reveal that our senses are to a great degree subjective. We know that our senses transmit the observations depending on their organic functioning and on what could be called our mathematical or geographical reference points. Those of us who have been working in different cultures know how our observations are also culturally bound. We see a small tree on the left side. With the concepts of distance and geographical point, we can correct the subjective observation and we know that the tree is actually a huge one and that it could also be on the right side. We correct the subjective observations by thinking. Reflective thinking allows us in principle to select the motive of actions. By thinking we can select a more powerful motive than even the biological needs, as those who voluntarily starve prove – the Maslow hierarchy of needs can be overcome in real life.

If a man does not think reflectively, i. e. does not select the motive of his action, he or she is not acting but only reacting and more or less automatically interacting with the environment. The actions can be explained causally: i. e., the cause comes first, and its nature is either material or relational. If the behavior is based on thinking, man is acting, the cause comes later and the nature of the cause is mental.

This means that if we want to change the social functioning ability on purpose, we have to include the category of consciousness. This is not to say that we deny the existence of architectural barriers, housing, employment, skills, emotions, etc.

3.3 Who is the originator of action?

A person with disabilities will be integrated by functioning based on the integrating concepts. A person is acting when he or she has selected the motive of the action. Then he or she is the originator of the action. In all other cases, the originator of the action is not the individual. Action is in these cases determined either by nature (needs), or a school of thinking (desires), but not by man.

When meeting a person with disabilities and at the same time observing one's own emotions, one discovers that disabilities arouse negative feelings. When gauging the negative emotions, we find them to be the stronger the less the person with disabilities is the originator of his or her own actions. Most rejected are persons whose mental problems are so severe that they do not even speak of themselves as „I". Negative emotions are – if we do not intervene with reflective thinking – connected with segregating concepts.

Whatever allows me to differentiate a system (be it a cell, a person, or social organization) from its environment gets an „identity". It can be strong or weak. The stronger it is, the more a person (or a social system) is the originator of his own actions, in other words: is autonomous.

It may sound like a contradiction but the more autonomous a person is, the more the person can base his functioning on integrating concepts by reflective thinking and thereby increase integration. All that has been said earlier indicates how important it is to learn the art of reflective thinking.

We can now define social functioning ability as the ability to actualize one's identity. The development of social functioning abilities starts with consciousness – introduction of integrating concepts, learning of reflective thinking and objective observation –, grows into functioning (changing) with human relations and into participation by consumption and possibly production, and may even lead to changes of the physical environment.

4. Adjustment training

The development of the modern concept of social functioning abililty is the result of the work of two separate groups. The first group can in honor of its initiator be named the Veikko Niemi group working with RIFI (RI Finnish Committee). It has theoretically analyzed and defined social rehabilitation and social functioning ability. The Tampere definition is one of the results. Much of its work has been based on the findlings of Tapani Purola, professor of social policy at the University of Helsinki. The other group can be named Marja-Liisa Heiskanen group. It was appointed by the National Board of Social Welfare to make proposals for adjustment training courses. Administratively, the groups are independent, but there have been a lot of discussions and both of the groups share several persons.

Organizations of the handicapped have launched adjustment training courses since 1963. The courses aim at integration by developing the social functioning ability.

There have been courses for different diseases: aphasia, cerebral palsy, multiple sclerosis, deafness, coronary diseases (even by-pass patients), low back pain, mental health problems, mental retardation, and paralyses. Lately, a shift has occurred from facts (unchangeable conditions, disease) to problems (changeable conditions, social functioning).

Preferably, a social group (family) participates. The practical work usually is being done by an organization of the handicapped. Some 180 courses per year have been arranged by local governments (medical and social services) under the Handicapped Persons' Act, some 150 courses per year by the National Social Insurance Institute, and about 50 courses per year by the organizations of the handicapped. The average number of rehabilitees is about 10 000 per year.

The average duration of a course is 2–4 weeks, preferably with a follow-up course later on. Courses in intervals are recommended for MS and similar diseases. Courses on a live-in basis are preferred. Different educational, training, counselling and instruction methods are used during the courses. Most of the work is done by the „learning by doing" method: practical instruction, group and individual discussions on actual facts and problems, and „orienting concepts" – a few short, introductory lectures.

The evaluations show that usually neither the disease nor the impairment are improved – in the majority of the cases this would be impossible: an amputation, lost sight, etc. will remain, and the medical aim has in general been to prevent development of additional symptoms.

When the disability is not so severe – the abilities as classified by the WHO proposal are sometimes much improved but generally just a little. We have noticed that the grading of the WHO classification is applicable only for severe disabilities. The handicaps suggested by the WHO proposal are improved, but the most important results are not dealt with.

When looking at the interaction of the social unit and the service system we notice that the requests for help from the outside become more balanced, i. e. after adjustment training a service is requested only when really needed, and the request is addressed more often to the service delivery system in charge – misuse of services decreases.

The social unit participates more in the activities of society. Inside the social unit, the work is better shared than before, skills to ask and provide help have increased, relationships are more balanced, and when conflicts arise the skills in dealing with them have improved.

Last, but not least: After adjustment training the autonomy of the social unit (be it a person or a family) has increased: the units have learned to use reflective thinking, they usually have an integrating goal, a future with something positive to work for. The adjustment training has provided an opportunity to find positive meanings, and some participants have taken advantage of this opportunity.

22 years of Finnish adjustment training have proven that it is a powerful rehabilitation measure – at least in the Finnish context.

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Behavioural assessments of physically disabled patients: Agreement between rehabilitation therapists and nurses

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Behavioural programmes depend on the setting of specific targets and continual monitoring of the behaviour throughout the programme. For patients receiving multidisciplinary care, these assessments may be made by more than one profession, and there may be interdisciplinary discrepancies.

Our previous work has shown discrepancies between nurses and patients in the assessment of surgical patients' pain and worries (Johnston, 1976, 1982). Compared with the patients, nurses overestimated worries and underestimated physical distress. The work to be reported examines discrepancies between staff working with shared patients.

Discrepancies between staff from the same discipline have been shown previously. For example, Marteau and Baum (1984) have shown systematic differences in estimates of the seriousness of diabetes between doctors working with adults and with children; the paediatricians rated juvenile onset diabetes to be less serious than their colleagues in the adult departments. Nuttall and Elderton (1983) have found that dentists differ in their decisions about need for restorative dental treatment. It seems even more likely that staff from different disciplines should show discrepancies.

While multi-disciplinary working brings the assets and skills of varied disciplines to the care of the patient, differences in training and experience are likely to influence assessments and judgements and may result in disagreements between staff. Training is likely to influence the schema which the individual develops to understand and treat patients' problems; each profession will make finer discriminations within their field of expertise and will be able to see the relevance of their particular kind of therapy. In addition, each profession has experience of somewhat different patient groups and therefore has a different set of examples available on which to base their judgements. For example, nurses working on a surgical ward will be familiar with patients experiencing considerable pain and may therefore judge pain to be serious only if it exceeds the typical post-operative pain; this might explain their tendency to underestimate patients' pain (Johnston, 1976). Nurses working on a medical ward might adopt a different standard for pain.

Patients with physical disabilities are treated by many disciplines – medicine, nursing, physiotherapy, occupational therapy, clinical psychology, etc. Their assessments of the patient's condition determine the demands that are put on the patient, the amount of rehabilitation received, the planning of the patient's discharge and so on. Where the disciplines agree, the patient is likely to reap the benefits of multi-disciplinary care, but where there is disagreement, confusion and conflict about targets and achievements may occur and detract from optimal care unless the discrepancies are resolved in teamwork.

The following studies were undertaken to explore the amount of agreement and possible discrepancies between staff of different professions caring for physically disabled patients. The judgements involved were assessments of disability, prognosis and level of care required.

I. PILOT STUDY

All in-patients in a district general teaching hospital who were sent to the physiotherapy or occupational therapy departments for regular treatment off the ward were identified, and 4 weeks later all staff participating in each patient's care were interviewed about the patient's disabilities and prognosis using a standardised assessment schedule. The views of staff of different professions treating the same patient were then compared. Since the two professions most commonly involved and giving the greatest number of completed interviews were nursing and physiotherapy, the comparison of their assessments is of greatest interest.

1. Results

Sixteen patients undergoing rehabilitation were each independently assessed by a nurse and a physiotherapist directly involved in their care at 4 weeks after the rehabilitation programme commenced. The results of the standardised assessments showed that the nurses judged the patients to be significantly more disabled than did the physiotherapists on items such as: getting in/out of bed, standing, etc. While the professions agreed on the likely time of discharge, there was a tendency for the physiotherapists to expect the patients to be discharged to a less institutional form of care, consistent with their assessment of less disability. Full details of the results are given in Johnston (1984).

The results suggest that nurses and physiotherapists working with the same patients may have quite different views of the patients' abilities and potential, which may affect the day to day targets of care. However the design of the study resulted in too small a sample of patients, and only two professions were compared. Therefore a second study was designed to allow comparison of nurses and physiotherapists (PTs) on a larger sample of patients and to give a parallel comparison of the judgements of nurses and occupational therapists (OTs).

II. MAIN STUDY

1. Design

Two separate groups of patients receiving rehabilitation in a teaching district general hospital were identified by random selection from the list of patients in treatment by PTs and OTs. Within 24 hours of selection the nurse and the PT or OT involved in the patient's care completed standardised assessments of the patients' disabilities, problems and prognosis.

(1) *Therapists*

All PTs (14) and all OTs (6) treating in-patients with disabilities in the physiotherapy or occupational therapy departments (i. e. off the ward) were included in the study. All were qualified therapists, the PTs being qualified for an average of 4 years 7 months and the OTs for 17 months.

(2) *Nurses*

Fifty-seven nurses working on 18 wards participated in the study. Each was identified following the selection of the patients as the nurse assigned to the patient on the day prior to the study day. Since the hospital used the Nursing Process, these were the nurses in most direct contact with the patients on the day they received treatment from the reporting therapists. There were 42 student nurses, 16 in 1st year, 5 in 2nd year (including 3 RMN students doing general secondment), 13 in 3rd year, and 8 in 4th year. Of the 15 trained nurses, 8 were 1st-year staff nurses, 4 2nd year, 2 3rd year, and one had been qualified for 7 years. Non were Sisters as might be expected from the criterion of patient assignment,

(3) *Patient Selection*

On each day of the study, the research worker selected a therapist randomly up to a maximum of three times from the list of 20 therapists. The therapist was then asked to list all disabled patients whom she had treated (assessments were excluded) on the previous day. Three patients were selected randomly from this list and were assessed on the research schedule by the therapist and the relevant nurse. Patients were only included if both nurse and therapist could be interviewed and if each had cared for the patient on at least two occasions. Thus neither nurse nor therapist knew in advance that she or her patient would be included in the study but both could be expected to be well-informed about the patient's current state. To avoid problems of remembering over the weekend, Friday patients were omitted and Monday was not a study day. On some occasions a therapist was not present, in which case another was selected, or there were less than 3 relevant patients, or the relevant nurse was not on duty, resulting in missing data.

Satisfactory data were collected for 52 physiotherapy patients and 32 occupational therapy patients, and details of these patients are summarised in Table 1. The mean age was 69.5 and 71.4 years respectively, and patients came from 15 and 13 wards. The most common diagnosis was CVA, the most common ward was the neurosurgical ward.

Table 1: *Study patients*

	PT group	*OT group*
N:	52	32
Age: < 60	9	3
60 - 69	10	8
70 - 79	15	15
> 80	18	6
Sex: male	16	12
female	36	20
Diagnosis: CVA	15	15
fracture	10	3
tumour	6	4
amputation	3	5
chest infection	4	1
other	14	4

2. Procedure

When patients had been selected, both the therapist and the appropriate nurse were independently interviewed to complete the same standardised assessment of the patient that day. Assessments were a development of those used in the pilot study and included:

(1) *Current Disability*

For each of the daily-self care and mobility activities listed in Table 2, the respondent was asked, "What is the patient doing now?", using the responses:

(1.1) without any mechanical aid or help from others
(1.2) using a mechanical aid but no help from others
(1.3) with supervision, but no physical help
(1.4) with help of 1 person
(1.5) with help of 2 people
(1.6) not doing it at all
(1.7) don't know

The responses were designed to describe critically different behaviours by the carer.

(2) *Problems*

The respondent rated the patient's current state of pain, incontinence, communication difficulties and mental/psychological problems on a four point scale – not at all/slightly/moderately/very much.

(3) *Prognosis*

Expected improvement in disabled patients over the next month was rated on the same four point scale, likely discharge time was rated – less than 1 week / 1–4 weeks / over 4 weeks –, and likely discharge destination was selected from – own home / home of friend or relative / Local Authority home / Rehabilitation Unit / Geriatric Hospital / Mental Hospital / Other or "Will not be discharged".

Table 2: *Current disability ratings*

Activity	*PT group*				*OT group*			
	no. *ind*	% *agr*	> dis by *PT*	*N*	no. *ind*	% *agr*	> dis by *OT*	*N*
Transfer to/from bath	0	59	5	9	0	71	3	5
Walks 50 yards	0	60	11	9	0	41	12	5
Walk 6 steps	2	40	11	19	1	42	5	* 13
Stand	2	29	8	* 28	4	35	6	* 14
Dress	5	53	11	12	13	75	2	6
Get in/out of bed	7	49	2	+ 24	9	55	5	9
Transfer to toilet	5	47	7	* 19	11	65	3	7
Get in/out of chair	8	49	3	+ 23	11	53	3	* 12
Roll over in bed	19	59	6	* 15	15	53	6	8
Cut up food	19	63	8	10	18	66	3	8
Pour out drink	24	63	1	+ 17	22	72	1	* 8
Wash hands/face	29	67	7	10	26	81	1	4
Feed self	39	86	3	4	28	88	2	2

* $p < .05$ (sign test)
+ $p < .001$ (sign test)
no. ind = number of patients rated independent by both raters
% agr = % of patients given identical ratings by nurse and therapist
< dis by = number of patients rated more disabled by . . .

3. Results

(1) *Current Disability*

Table 2 lists current activities roughly in order of difficulty and summarises the results.

The level of disability of the groups is indicated in the 1st and 5th columns, which give the number of patients performing the activity independently, without aids, according to both raters. No patient in either group bathed or walked 50 yards independently, but over a quarter fed themselves and washed their hands and faces.

The next columns indicate the percentage of patients for whom there is agreement between therapist and nurse, and ranges from 29 % to 86 % for the PT group, and from 35 % to 88 % for the OT group. Since each step on the scale indicates quite a different strategy for performing the activity, any disagreement is important and suggests that within the previous 24 hours, the nurse and therapist most directly involved in the patient's care had different expectations about how a regular daily activity was being performed. While the ratings are above chance level of agreement, there are few activities where nurse and therapist would agree on the handling of three-quarters of the patients. Considering each patient, there was full agreement between nurse and therapist for only 1 patient in the PT group, and for none in the OT group; thus all except 1 patient might have experienced conflict over the performance of these routine activities.

There was some measure of agreement, using approximate median splits, most activities had significant coefficients of concordance, where these could be calculated.

Disagreements are analysed in the final two columns for each group. For almost all of the 13 activities, the nurse rated the patient more disabled than did the therapist, for both groups; the only activity on which therapists described patients as more disabled was walk 50 yards. Thus, there was a significant overall tendency for therapists to rate patients to be more able and this is specifically significant (sign test) for 6 activities in the PT group and 4 in the OT group.

In summary, nurse and therapist rarely agreed completely about a patient's current performance, even using crude categories, and when disagreement occurred, the nurse was likely to rate the patient more disabled than the therapist.

(2) *Problems*

Table 3 lists the 4 problems considered, and the 1st and 5th columns indicate the number of patients agreed to have no problem; clearly, incontinence was a rare problem in the OT group. For all other problems and all problems in the PT group, nurse and therapist agree on less than three-quarters of the patients. Even when the category ratings 'slightly' and 'moderately' are collapsed to give a 3 point scale with gross categories, the percentage agreement only rises to 50, 65, 63 and 49 % for the PT group and 56, 89, 75 and 44 % for the OT group, for pain, incontinence, communication and mental/psychological respectively.

Table 3: *Current problem ratings*

	PT group				*OT group*			
	no	%	worse		no	%	worse	
Problem	*prob*	*agr*	*PT*	*N*	*prob*	*agr*	*OT*	*N*
Pain	9	40	21 *	10	11	50	11 *	4
Incontinence	21	65	4 *	14	26	89	2	3
Communication	18	56	7 *	16	18	72	5	4
Mental/psychological	9	37	10 *	21	6	34	10	11

* p<.05 (sign test)
no prob. = number of patients rated as having no problem by both
%agr = % of patients given identical ratings by nurse and therapist
worse = number of patients rated worse by . . .

Where disagreement occurred, there were systematic differences between the therapists and nurses. Therapists rated the patients' pain to be more severe than the nurses rated it for 32 patients, nurses giving more severe ratings for only 14 patients in the two groups. For incontinence, communication, and mental/psychological problems, the nurses more often gave a worse rating than the PT; nurses and OTs did not differ. These differences may reflect the experience of the two professions of the patients, with the therapists more involved in activities which elicited pain and nurses observing the patients for longer periods of time when the other difficulties might become apparent. OTs may perform activities with patients which detect these other problems even in therapy sessions of moderate duration.

(3) *Prognosis*

(3.1) *Progress*

All except 2 PT patients with disabilities were expected to improve in the next month by both nurse and therapist (Table 4). Agreement about the degree of improvement was about the chance level. For both groups, the therapists expected significantly more improvement.

Table 4: *Expected improvement ratings*

Group	*no improvement*	*% agreement*	less expected by *therapist*	*nurse*
PT Group	2	35	10 *	23
OT Group	0	22	7 *	18

* p<.05 (sign test)

(3.2) *Duration of stay*

When asked to rate the likely discharge time, 17 nurses in each group, but only 8 PTs and 1 OT ticked 'don't know'. Percentage agreement on the remaining 3 point scale was high, 67 % and 79 %. It is not clear whether nurses' reticence about offering estimates indicates a lack of authority/judgement in this area or an expectation of a long but uncertain stay.

(3.3) *Discharge destination*

Both therapist and nurse agreed that 18 of the PT group and 16 of the OT group were likely to be discharged home (Table 5). If all allocations other than to the patient's own home are called care, than all patients allocated to care by therapists are also allocated to care by nurses, but nurses allocate more, but not significantly more, patients to some form of care.

Table 5: *Expected discharge destination ratings*

		Nurse ratings				
		Home	Care		Home	Care
Therapist ratings	Home	18	6	Home	16	5
	Care	0	12	Care	0	3
		PT group			*OT group*	

III. DISCUSSION

This study has explored the agreement between rehabilitation therapists and nurses about fundamental targets of the care of patients they share. It was designed to maximise the level of agreement by only asking for critical judgements, by using judgement categories that reflected different behaviours involved in providing care, by limiting disability ratings to what the patient was currently doing rather than could do or had been doing, by ensuring that they had seen the patient in the last 24 hours, and by ensuring that they were the key therapists/nurses.

Nevertheless the level of agreement achieved is not very high, and it is clear that the typical patient receiving off the ward rehabilitation therapy in this hospital would regularly be given care by staff who assessed his or her disabilities and problems rather differently. No data was collected on the patient's experience, but it is likely that rehabilitation and nursing staff made very different demands and had different expectations. Patients may be able to make the discrimination that there is one way of performing an activity in the rehabilitation department and another on the ward, but may be rather confused about how to perform after discharge; indeed, the therapists may have different expectations about the patients' discharge arrangements.

In both the pilot study and the main study, the rehabilitation therapists saw the patients as less disabled than did the nurses. This may reflect differences in what they typically see the patient doing. However they were asked what the patient was actually doing and the consistent discrepancies suggest that there was a failure to communicate between the ward and the rehabilitation departments. If the therapist did not know what the patient was doing on the ward, then it was unlikely that she was planning the most appropriate level of therapy, then she may have been helping the patient unnecessarily or even depriving the patient of the opportunity to practise new activities.

The activities described in Table 2 have a different significance on the ward and in the rehabilitation departments. In therapy, they are exercises to be practised whereas on the ward they are means of achieving an objective. Patients transfer to the toilet on the ward in order to use the toilet, but in therapy they may practise the transfer many times without actually using the toilet. These objectives may have a higher priority for nursing care while the exercising has the higher priority in rehabilitation. Nurses may not always have the time to carry out the activity in the maximally independent manner that allows the patient to practise, because it is more important to get the job done. Thus it may be quicker and easier for two people to transfer the patient into the bath than for one person to supervise the patient learning the skills that will be necessary to bathe at home. It might be profitable for rehabilitation therapists and nurses to share objectives for such patients.

The nurses appear to have had lower targets, expecting patients to make less progress in overcoming their disabilities, being more uncertain about when they would be discharged and tending to expect discharge to a caring environment rather than the patient's own home. This might either be explained by their assessments of the patient's abilities or their lower targets might lead them to be less concerned about disability.

Nurses are with the patients for much longer periods of time and for a wider range of activities. It is possible that they were more realistic about what the patient could achieve. In addition, patients are more likely to seek their attention when they are having problems or needing help, whereas the rehabilitation therapist typically designs situations for practise that are just within the patient's reach and therefore elicit success. This might explain the nurses' more frequent perception of incontinence, communication and psychological difficulties in the PT group. The therapists saw the patients as experiencing more pain, and this may also reflect the difference in activities undertaken by the two professions, the therapists asking the patients to perform more painful manoeuvres. However the nurses are likely to be more involved in the administration of analgesia and should be aware of the pain experienced by the patient.

These results are reminiscent of the findings of Johnston (1976), comparing nurses and patients on ratings of surgical patient's pain and psychological problems. In both studies, the nurses gave the lower ratings of pain and the higher ratings of psychological problems, the comparison being with the patient's own scores in that study and with the rehabilitation therapist's scores in this study.

One possible explanation is that the nurses have a higher threshold for recognising pain because they are familiar with it as a part of their work. Disability is not necessarily part of nurses' routine as is it is for the therapists; as a result nurses may have a relatively low threshold and rehabilitation therapists a relatively high threshold for recognising disability. It is not clear why they should give higher scores for psychological difficulties.

Thus the discrepancies between therapists and nurses may arise due to differences in training and in their experience of patients. In planning behavioural programms, it may be useful to reach agreement in assessment of current performance and in setting targets, especially where more than one profession is involved.

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Report from working groups 5 a and 5 b

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The presentations in working group 5 a: "Evaluation of teaching methods, programmes and material in special education", highlighted the difficulties of evaluating the effects of education. The purpose of education is to develop and improve the attitudes, knowledge, performance and skills of its recipients. Of these goals, only the evaluation of recipients' attitudes to the education process itself was described, and this in only one of the presentations (Unsworth and Clayson). Evaluation of the effects of an education package upon the educators poses fewer problems, and Hegarty described his experiences with the staff development pack designed for teachers of educationally subnormal children, showing that they liked it, used it in a manner anticipated by its designers, and had a better understanding of the special requirements of subnormal children as a result. Hegarty expressed the view that it was impossible to establish whether such changes had improved the education of the children and therefore questioned the need to try. It was clear that evaluation of the educational method was a different matter from the evaluation of the progress of individual children, but some members of the working group felt that both outcomes should be capable of formal evaluation.

Further discussion emphasised the distinction between making a value judgment on the outcome of education and showing that a particular approach had altered the outcome. Evaluation could establish that change had occurred without necessarily establishing that the change had been beneficial. Bauer proposed some models for evaluating the current popular strategy of integrating disabled children into normal schools, pointed to the paucity of scientific evaluation of outcome in the literature, suggested that professional insecurity discouraged teachers from attempting such evaluation, and emphasised the necessity for long-term follow-up.

The approaches to evaluation were even more disparate in group 5 b: "Behaviour modification and therapy." Methods of assessment ranged from well-validated rating scales of restricted application (Philip) to a totally unstructured and intuitive description of the effects of psychotherapy (Baum). One of the problems of evaluating behaviour is the unreliability of the instruments available. In assessing emotional upset after myocardial infarction, Philips demonstrated that a method based upon studies of normal populations in academic psychology (Cattell) identified very few abnormalities while a symptom-focussed scale

(Goldberg) showed a significant disorder in over 30 % of the patients. This finding illustrates that results obtained by one instrument should not directly be compared with results obtained by a different one. The work presented by Johnston et al. suggested that the professional background of the assessor may be an equally important variable. Using simple four-point scales, Occupational Therapists, Physiotherapists and Nurses assessed the same group of patients and recorded remarkably disparate results, even with such apparently simple functions as the ability to walk 50 yards or turn over in bed without help, and the presence or absence of urinary incontinence. The reasons for these discrepancies between members of what is supposed to be an integrated team are not clear, but Johnston et al. suggested that the specific attitudes and previous experience of different professions was a major factor in determining the wide range of thresholds applied.

Despite these formidable difficulties in evaluation, behaviour modification therapy is taking place in many areas of rehabilitation. Some of the methods and theoretical principles underlying them were helpfully reviewed by Muthney and Haag, and Matinvesi outlined the remarkable series of some 380 courses per year run by the National Board of Social Services in Finland, which now serve 10,000 people. He stated that such courses have not been shown to have a significant effect upon disease or upon impairment, but some disabilities and all handicaps tended to improve as a consequence of the courses. Unfortunately, time did not permit any description or discussion of the results themselves or the methods used to obtain them.

In summary, these two working groups identified some important obstacles to accurate evaluation. They also suggested a series of related targets that could help to establish in a scientific way the validity and relative efficacy of education and training programmes. Some contributors clearly stated that the quantitative, hypothesis-testing approach was appropriate only to medical (that is to say physical) disturbances and their treatment. Others considered that social and behavioural interventions are capable of evaluation provided that sufficiently sophisticated instruments are used over a sufficiently long period of time.

Group 6:

Methods of changing the social environment on purpose

Chair: Prof. Dr. med. Volkmar Paeslack, Heidelberg, Fed. Rep. of Germany

Providing gainful employment for emotionally disabled persons – A model of vocational integration

B. Seyfried, Berlin (Fed. Rep. of Germany)

This contribution gives a general account of new attempts in the Federal Republic of Germany to provide suitable jobs for emotionally handicapped persons.

These jobs are in enterprises on the general labor market and have been created especially in the interest of the emotinally handicapped in order to provide an avenue for social access to society. Just as certain physical changes concerning environment, transportation, buildings, etc. allow social access to public life for the physically disabled, the above mentioned group of persons needs certain social arrangements which accommodate their special characteristics (Bennett, 1985).

These enterprises came into existence in the late seventies when it became more and more difficult to find employment in existing businesses in the free labor market due to increasing general unemployment. Thus, the workshops for the handicapped, whose proper function was work training and provision of sheltered employment, more and more frequently turned out to be a dead end. These institutions moreover were rarely accepted by the emotionally disabled for various reasons, such as status, pay, anonymity. In response to these social problems the socalled self-help enterprises came into being on the initiative of mostly independent groups and institutions in the psychiatric sector.

Most of these initiatives have, however, been launched directly by psychiatric clinics or related bodies. The jobs are generally intended for patients of these clinics, e. g. following rehabilitation in work therapy. But these people may also come from sheltered workshops, via centers of vocational training or via institutions on an outpatient basis. All initiatives therefore are integrated into the existing support network but at the same time institutionally independent. All workers have more or less extended psychiatric careers, some having been in institutions for more than 10 years. A larger proportion of workers have been in and out of clinics over the years. Their common experience is one of not being able to find an appropriate job in the existing labor market. The general term "emotionally disabled persons" covers a range of psychiatric diagnoses across the full spectrum, including people with chronic psychotic disturbances and severe neurotic peculiarities of behavior.

1. Field survey

1.1 Number of projects

There are 25 projects altogether of this type in the Federal Republic today. 19 of these enterprises provide employment in line with general wage regulations. They pay standard wages, and contributions to social, health and unemployment insurance are deducted from the wages. 6 projects provide jobs only for additional income. These are jobs for persons who cover their living expenses primarily through public support, such as social assistance, or retirement pension. Wages play only a secondary role as additional income. 8 enterprises offer both kinds of employment, jobs with standard wages and jobs that provide additional income.

1.2 Number of jobs

A total of 256 jobs of this kind is available in the Federal Republic at present. 49 % (i. e. 127) of these jobs pay standard wages; 51 % (i. e. 129) offer part-time jobs for additional income only. A very high percentage of standard wage employment involves part-time jobs as well. In order to provide occupational integration of emotionally disabled persons, jobs are needed which are suitable for various conditions, needs and abilities of these persons regarding flexible working hours.

Table 1: *Distribution of employment. (*The figures in brackets refer to additional income employment; **changing orders do not allow detailed classification.)*

1. Service Sector		
– transport / house clearence	15	(15)*
– second hand shop / junk shop	9	(11)
– office work	11	(1)
– large-scale catering	7	(4)
– laundrette	4	
– sales (health shop)	2	
– hairdresser's		(2)
– café		(2)
Services sector total		(51)
	48	35
2. Industrial Sector		
– metalworking**		
– mounting and packaging	50	(45)
Industrial sector total	50	(45)
3. Trade		
– printer's	5	(22)
– joiner's workshop / wood work	11	(5)
– bicycle repairing and sales	3	(5)
– baker's trade	4	(1)
– sewing		(3)
– repair service	1	(1)
Trades total	24	(37)
4. Agriculture		
– gardening, farming**		
– sheep-breeding	5	(12)
Agriculture total	5	(12)
	127	(129)
5. Total	= 256	

1.3 Nature of Employment

The Table 1 shows the distribution of employment according to available types of work. As shown by the Table, employment for additonal income dominates in the agricultural and trade areas. I assume that this does not only result from the needs of the employees, but is also caused by the generally difficult economic situation in agriculture and trade in the FRG. The proportion in the service sector and in industrial production is almost equal.

The very high share of service sector employment may come as a surprise. As as rule, emotionally handicapped persons are regarded as unsuitable for this kind of employment and are excluded from this sector by the traditional workshops for the handicapped. Therefore we can say that the firms and businesses for the emotionally disabled have made the service sector accessible to this group of persons.

The importance of this aspect becomes clear when we examine the jobs offered from the point of view to which extent they provide the opportunity of contact with clients, i. e. general citizens. Since some of the jobs in the trade sector provide client contact as well, the proportion amounts to about 30 %. Observations indicate that the possibility of contact with customers provides a considerable effect of normalization and gains of status.

A relatively high proportion, namely about 23 % of the jobs, i. e. 29 (30), involve comprehensive working processes where a product is made from start to finish in a meaningful work sequence. In most enterprises spontaneous change of job within the firm can also be arranged.

1.4 Financing of enterprises

In the following, I differentiate according to initial costs, current costs, and costs for attending personnel.

1.4.1 Initial financing

Initial investments are mostly covered by public subsidy. The establishment of jobs for the handicapped is publicly promoted in the FRG. Part of the funds originate from foundations or private contributors. Loans were only very rarely used for financing so that as a rule hardly any charges for interest or repayment burden the enterprises.

1.4.2 Current costs

The above mentioned fact is of advantage for the projects, since more leeway is left to make enough profit to cover current costs for wages, raw materials, other materials, etc. The majority of projects are self-supporting. If this is not the case, external assistance is obtained in order to subsidize wages, e. g. subsidies from the Social Funds of the European Community.

1.4.3 Costs for attending personnel

The costs for attending personnel are not covered, but then this was not the goal of the projects. The requirements for personnel are usually covered by public subsidies.

1.5 Integration goals

The aim of these enterprises and projects is to provide employment for the emotionally handicapped that accommodates their needs, possibilities and abilities. The duration of employment is basically unrestricted. Even in a case of an emotional crisis entailing prolonged in-patient treatment, the job is saved for the person concerned. The comparatively low turnover underlines the importance of a secure, permanent job which suits their needs.

2. Qualitative results

Qualitative data presented in the following have been gained from structured interviews and by participating observations.

2.1 Status

A permanent job in such an enterprise is connected with a considerable gain in status for the employee. On the one hand, this is linked with the employee role: one defines oneself as worker, no longer as patient or handicapped person (Bennett, 1975). On the other hand, it is linked with the daily interaction with non-handicapped persons. Furthermore, the environment is much less stigmatized by a ghetto atmosphere than in the workshops for the handicapped.

This becomes apparent in the following interview quotes: "What did you gain by working here so far? – A boost to my ego, being able to work in a normal enterprise again, and not only in the workshop for the handicapped . . . – What exactly do you mean by boost to my ego? – You really are somebody, also amongst friends. And maybe find a girl again. Before, I did not dare look for one, being in the workshop. To start with because of money and secondly because I was in the workshop for the handicapped . . ."

2.2 Wages

Analyses show that apart from the question of status, the amount of pay is an important factor concerning employment of the handicapped. Another interview quote: "What does your job mean to you? – That I can afford my own place, that I can invite whoever I want to and whenever I want to . . . Before I had 150 DM every two weeks, from this I had to hand over DM 50 to my mother because I stayed at her place. What can you do with DM 100? It's no fun to look at your own four walls all the time, never to be able to leave the house."

The average income per month cannot be determined exactly, since varying arrangements for working hours and pay do not permit such a generalization. The figure is around DM 900 net per month taking a work week of 30 hours as a basis, and may go up to a monthly income of DM 1400 net for a working week of 38.5 hours. The ideas emotionally disabled persons hold about the amount of pay as a rule exceed the extent of what they are actually capable of earning.

2.3 Type of work

Clearly structured working processes and clearly defined functions prove to be helpful. The emotionally handicapped often feel overburdened by complex tasks.

The positive importance of comprehensive working processes was not proven by the analysis. On the contrary, it became obvious that workers took little interest in the actual product and had an indifferent attitude towards the various activities. "I don't care where I work", would be a typical statement. The actual job is primarily important for its social aspects, "With whom do I work?" being the question of interest. In those cases where the available jobs allow for rotation, changes are made with a view to changing social contacts. Such changes take place frequently in order to overcome problems of interpersonal relationships and to achieve that amount of social contact the person concerned is capable of.

2.4 Worker participation

In almost all enterprises, the workers are offered ample opportunities for worker participation in internal decision making. Experience shows that workers rarely utilize these opportunities. Making an important decision appears to overburden the emotionally disabled. Quote from an interview: "I can't participate because I don't know the first thing about it. – How could that be changed? – Not at all, because I . . . when I am working I don't feel the need to get involved in big business on top of it all and to shoulder responsibility. If something went wrong I really wouldn't be able to cope with it."

2.5 Cooperation

Analyses of the qualitative data indicate that the cooperative and social aspects of work are of vital importance for the emotionally disabled. This is expressed in statements underlining repeatedly the importance of social conditions and social relations among the workers. The work place becomes some kind of an emotional home for many of them at times. This is manifested for instance by the fact that the workers come to their work place even on their days off. Quote from an interview: "We get together here, have a chat after work, stay around a little longer and later give others a call . . . Outside we keep in touch too. At other jobs I used to finish work and leave because I didn't want to know anything about the other people. But here, I really want to find out things."

This feeling of belonging occurs mainly when the emotionally disabled including their limited capabilities are respected. This acceptance relieves the handicapped of the burden to live up to extreme expectations.

The lack of constant performance, and fluctuations in achievement levels are normally compensated by the non-handicapped fellow workers. They mostly hold some kind of supervisory position towards the handicapped. Experience shows that explicit distribution of roles facilitates the orientation of the person and his view of the structure of the work situation (Seyfried, 1985).

Interpersonal problems and tension between handicapped and non-handicapped workers arise when fluctuations of achievement can no longer be interpreted as a manifestation of being handicapped, but appear to be due to voluntary irresponsibility or lack of consideration (Seyfried & Stadler, 1985). All persons must concern themselves continuously with the extent of acceptance of the handicap. This is important in the interest of better cooperation between handicapped and non-handicapped persons, but also because acceptance of their handicap and their personality is closely tied in with a sense of social belonging for the handicapped worker. This process is facilitated by the assistance of psychological and social specialists.

3. Conclusions

The field survey indicates that the number of models of employment for the emotionally handicapped has steadily increased. These models fill an important gap betweeen normal businesses in the general labor market and the traditional workshops for the handicapped.

Because of the importance of the social dimensions of work, vocational and social integration into small and distinct units offering constant social relations appears to be particularly appropriate for the emotionally disabled. This approach is much more appropriate than integration into an anonymous large-scale insttution. In particular through cooperation with the non-handicapped, vocational integration can be linked with social integration. However, it appears necessary to deal with upcoming problems of cooperation through psychological and social support on the job.

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Architects supporting the integration of the disabled within the community

A. E. Galkowski, Poznań (Poland)

The year 1981 was proclaimed the "International Year of Disabled Persons" by a resolution of the United Nations Assembly in 1976. The keynote theme was "Full participation and equality". The motto introduced in the Federal Republic of Germany "To understand each other – to live with each other", and the leitmotiv of the opening day of the forum with REHA-85 read "You with us – we with you".

The need for integration was recognized as early as in the sixties by Professor Brattgard, of Sweden, who initiated through the FOKUS foundation the then innovative concepts of apartments for disabled persons within general housing projects.

On April 26–30, 1985 an international symposium took place in Hamburg. Its motto was: "Do you call this living? – Housing Problems of the Physically and Mentally Handicapped". It was organized by the International Cerebral Palsy Society, London and the Hamburger Spastikerverein. One of the aims of the conference was to seek new ways of enabling the handicapped to live under modern and humane conditions, and to establish standards such as those generally accepted for the nondisabled population.

The annual meeting of ICTA, the International Commission of Technical Aids, Housing and Transportation, held in concert with Rehabilitation International in June, 1985 in Helsinki, saw discussions and exchange of experiences about the newest concepts of full integration of disabled persons in social life. Among other events the participants could visit the largest passenger ferry "Finlandia" where ten cabins as well as club rooms and the sauna have been adapted for disabled persons in wheelchairs.

The purpose of the author is to show the role of the architect in implementing integration of disabled persons in the community. The architect is responsible for shaping the space which surrounds man on various levels: from town planning, to buildings, to ergonomic aspects of interiors, to furniture. The whole life cycle of man takes place in an environment designed by technicians – a technical environment whose physical features and spatial organization create a definite social milieu, which very often influences the way individuals, families and social groups behave.

In the authors' view, the following areas of man's environment can be distinguished:

(1) Private/personal area:

- one's own room in a family apartment
- one's own apartment
- one's own room in a shared apartment
- supervised residential group
- one's own room in a residential home

(2) Social area:

- the other rooms in a family apartment
- other space, e. g. corridors shared with other people
- rooms in a larger apartment, commonly used together with other members in supervised residential group
- rooms shared with other residents in a residential home
- the surrounding of the building – a garden around the house
- playground, leisure areas, kindergarten, school, service buildings – shopping, restaurants within walking distance or reachable by driving a wheelchair

(3) Public area:

- the spatially organized areas of the village
- a part of a smaller town
- a district of a medium sized town
- housing developments in a big city

The dynamic spatial development of large cities in this century with a rapid increase of the number of inhabitants caused a weakening or even decline of the social amenities provided by traditional town planning. Passersby in the street, passengers on a bus, clients at various institutions are strangers to each other. Concert halls, theatres and cinemas are visited by anonymous spectators and listeners. The public spaces in which social integration of disabled persons is possible, in the view of the author are limited by the distance which can be covered on foot or by a wheelchair.

However, one should empasize that it is the duty of architects to design all public and service buildings without barriers so that disabled persons can use them without restrictions and can work in them together with non-handicapped persons.

The architectural conditions for social integration differ for various age groups of disabled persons, i. e. kindergarten children and students at various school levels, working adults, elderly people. Private spaces and furnishings, including technical equipment, should always be adapted to the individual needs depending on the kind and degree of disability from an ergonomic point of view.

Pre-school children and school-age youth

The creation of conditions for unrestrained integration with the entire community of their peers in the area of social space is particularly important for a balanced psychophysical development of disabled children and young people. Important integrating factors are common games and learning. However, the architect's tasks are different with respect to children attending kindergarten and young people.

A gradual decrease in the ratio of games in favor of lessons takes place in the life of the youngest children until they finish elementary school. Since the first social contact of the child outside the family may take place in the kindergarten and the playground, they must be designed with complete elimination of any kind of barrier. That goes for buildings and the surrounding outdoor space. Ergonomic improvements should take into account the needs of disabled children, be they blind, visually impaired, deaf, hard of hearing, or have locomotor impairments. These improvements do not cause any inconveniences to non-handicapped children who learn in this way to coexist with peers whose physical abilities are different. Special care is required in designing facilities on the playground, which should enhance physical abilities. The construction and functioning of gymnastics equipment demanding physical exertion or stimulating intellectual development of a child should inspire the architect to look for nonconventional designs.

Organization of leisure time of children attending elementary schools is based on facilities located at some distance from their homes but usually in the vicinity of housing developments. Attention should be paid in particular to recreation, sports and games, adapted to the physical abilities of the disabled children.

Young people attending schools above the elementary level, which are often located at a greater distance, take the opportunity to live at boarding schools in order to avoid commuting. The needs of these students are similar to those of adults, especially concerning the development of interests that promote social growth. It is necessary to enable disabled young people to improve their physical development in a way adapted to the kind of handicaps by providing facilities especially designed for this purpose.

Working adults

To engage in paid work is important for the social adaptation of disabled persons. Thus, work should not to be treated as a way to fill spare time but it should be the privilege of every citizen. Depending on the kind of limitations of physical ability to work, employment should be available in companies, institutions, special plants, or – particularly for people using wheelchairs – in small service workshops in the area where disabled people live or in the disabled person's apartment if properly adapted.

The accessibility of all services, places for shopping and entertainment as well as restaurants is of fundamental importance for the integration of disabled persons.

In town planning and architectural design one should also remember to create opportunities for various forms of leisure time activities within buildings and housing developments. In this way, the necessity of using various means of transportation is reduced. On the other hand, group trips can be organized from time to time to city centers to visit theatres, museums and the like, or to health resorts.

Facilities to promote leisure and physical health

These in particular include:

(1) leisure areas in the green spaces surrounding homes and in gardens around housing development which are used by all residents and which are designed to accomodate the specific needs of the disabled people by special arrangements of foothpaths (width, slopes), pavements and elements of the socalled "small architecture": stairs, ramps, benches;

(2) sport facilities for disabled users, and depending on local needs, additional opportunities for corrective gymnastics under water, solaria and also "health paths" for jogging with various degrees of difficulty, archery practice fields, cycling tracks, and the like.

A second group of facilities should be directed towards developing intellectual activities and integration within the community of the housing developments with particular regard to elderly people. To establish service programs requires a thorough analysis of the needs of the residents. Although it is not possible to administratively organize leisure time of various groups of people, the architect who performs the role of "stimulator of social life" can indirectly influence the development of certain interests through proper design, for instance:

(1) multifunctional auditorium adapted for larger meetings, performances, films as well as discussion groups, and the like;

(2) special rooms for various groups of people with interest for instance in the field of arts, painting, sculpture, drawing, music, artistic handicrafts, and for hobbyists.

The retired elderly people

The changing demographic structure of world population, whose characteristic feature is a rapid increase of the percentage of elderly people, justifies particular attention on the part of architects to the problem of meeting housing and leisure time needs of retired people. Due to the decline of households consisting of several generations the problem of loneliness is serious in this group of people.

Unfortunately, the process of aging is accompanied by a gradual diminishing of man's physical abilities, and this must be compensated by specially designed facilities. Ergonomic requirements in this area are identical to the ones for disabled persons. Psychological and sociological reasons speak against placing elderly people in various kinds of institutions. This confirms an old proverb: old trees should not be transplanted. Elderly people should remain as long as possible in their own apartments or, if failing health requires it, in other forms of housing such as "supervised residential groups" or "residential homes".

The task of the architect always is to create the most advantageous combination of private space with social space, to facilitate social contacts with neighbors. Elimination of architectural barriers should ensure club rooms, workshops and service stations to be accessible. They should be situated within walking or wheelchair distance, to enable retired and disabled people to join the everyday live of the community. Other facilitiles which should be made accessible include painting studios, rooms for tinkering, modelling, glasshouses for growing flowers and lounges. One can often observe a tendency of elderly people to walk along busy footpaths and streets near shopping centers and in the neighborhood of playgrounds for children.

Concluding remarks

The great variety of problems which need attention justifies the fragmentary character of presentation of the most general principles to further integration of disabled people in the community. Because of limitations of the scope of this paper, the author has concentrated in particular on the needs of persons with locomotor impairments. However, attention should be paid to the specific requirements of the blind, visually impaired, deaf and hard of hearing.

In the author's opinion, the problems discussed require further interdisciplinary studies, the more so since changes in life style are a continuous process and force us to search for new ideas. The situation of disabled persons in the country and in non-urbanized areas is particularly complicated.

The following conclusions are drawn:

(1) Integration of handicapped persons in the community can be effectively aided by a conscious effort of the architect, and often it depends on it. An appropriately organized social environment stimulates contacts among neighbors.

(2) The fundamental principle should be that all residential buildings, service and public buildings become accessible to disabled persons to enable them to participate in various forms of social life.

(3) It is an urgent necessity to undertake and continue extensive interdisciplinary investigations by competent multidisciplinary teams in order to identify the needs of various groups of disabled persons concerning the elimination of architectural and social barriers. Participation of disabled persons in the work of such teams is indispensable according to the principle "nothing about us without us".

(4) In order to optimize investigations, it would be advisable to establish or expand international cooperation and to conduct joint work with institutions, associations and organizations such as:

- Rehabilitation International (RI), i. e. the International Commission on Technical Aids, Housing and Transportation (ICTA)
- International Union of Architects (IUA), i. e. the Public Health Group (PHG)
- The Swedish Institute for the Handicapped (Handikapp-instutet).

Using handicap-specific data of disabled workers to select adequate working tasks

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1. Introduction

The aim underlying most company concepts regarding the planning and design of workplaces for the disabled (Möhler, 1959; Wieland & Laurig, 1981; Kronauer, 1983) is to compensate for the various physical impairments or functional losses by taking specific constructional or organizational measures, such as the provision of work aids (Berning, 1975; Paeslack, 1981; Wieland, Laurig & Schulze-Icking, 1984). Such approaches as a rule take a person's "visible" disabilities as their starting point. Reduction of the disadvantage for the disabled person sough by means of workplace adaptation is achieved to the fullest extent only when knowledge regarding less conspicuous impairment, such as alterations to the spinal column or internal diseases, is also available. Information on the numerical distribution of disabilities and their combinations is therefore a prerequisite for methodical adjustment of workplaces aimed at improving the employment prospects of disabled persons. To his end an analysis of the results of a survey, conducted among severely disabled employees at the mining company Bergbau AG Westfalen giving details regarding the disabilities present, was carried out.

2. Decription of the random sample

The size of the random sample of severely disabled persons aged 25–59, was N = 1319. Referring to the total number of recognised disabled persons at the mining company Bergbau AG Westfalen of approximately 3,400, the random sample therefore represents around 40 % of the total. It is concerned exclusively with male workers with a reduction in earning capacity of between 50 and 100 percent, who volunteered information about the nature of their disability and who had agreed to their data being recorded on index cards.

Since the proportion of older workers typically is higher among severely disabled persons in general (Federal Statistics Office), it is to be expected that this will be similar in the random sample presented here. Age distribution is shown in Fig. 1. 51 years is the median (Md). The interquartile range 1–50 amounts to 6 with the result that the "central" age levels in the distribution are located in the range between 48 and 54 years. The coefficient of bias 1 calculated according to the relation (Q3 + Q1-Md) / (Q3 − Q1) (Sachs 1978), which adopts the value O for a symmetrical distribution and varies at a maximum within the range −1 and +1, amounts to −0.33 and therefore shows a negative bias for the distribution presented here. The excess 2 determined according to the formula (Q3 − Q1) / (2*(DZ9-DZ1)) amounts to 0.25. Compared with the value characteristic of the Gaussian bell curve of 0.263, the distribution presented in Fig. 1 therefore reveals a curvature of almost normal distribution.

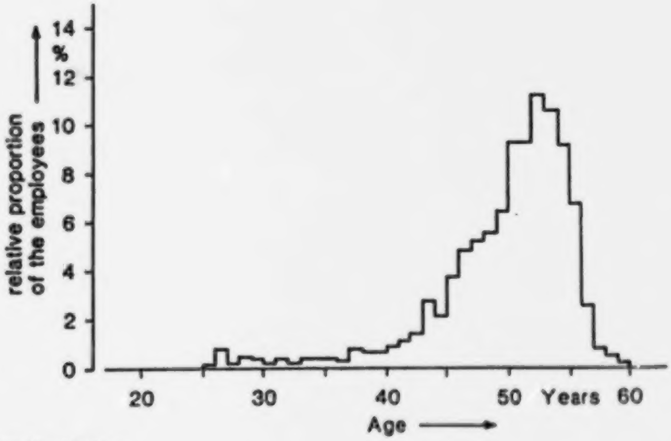

Figure 1: *Age distribution*

3. Determining the distribution of the disabililties

The recording and coding of both impairment and functional limitations was carried out according to a classification scheme with a total of five distinct disability complexes which differentiated between impairments

(a) of the physical structures required for support and motion,
(b) of the speech organs,
(c) of the sense organs,
(d) of the nervous system and
(e) between other damage and limitations which cannot be assigned to the groups previously mentioned.

This classification system provides two further description levels: disability groups and types. The distribution of the individual disability groups is shown in Fig. 2. The greatest proportion of those interviewed, i. e. over 60 %, has damage to the spinal column, i. e. disease of the cervical, lumbar or thoracic spinal column or of the sacrum or coccyx, with 59 % of the total random sample revealing damage to the lumbar spinal column.

Over 50 % of the employees questioned are affected by circulatory or vascular disease, manifested in particular by fluctuations in blood pressure or arterial hypertonia. Impairments of the lower extremities occur in 43 % of the cases, with damage to the knee joint reported most frequently. 40 % of the random sample have respiratory system diseases.

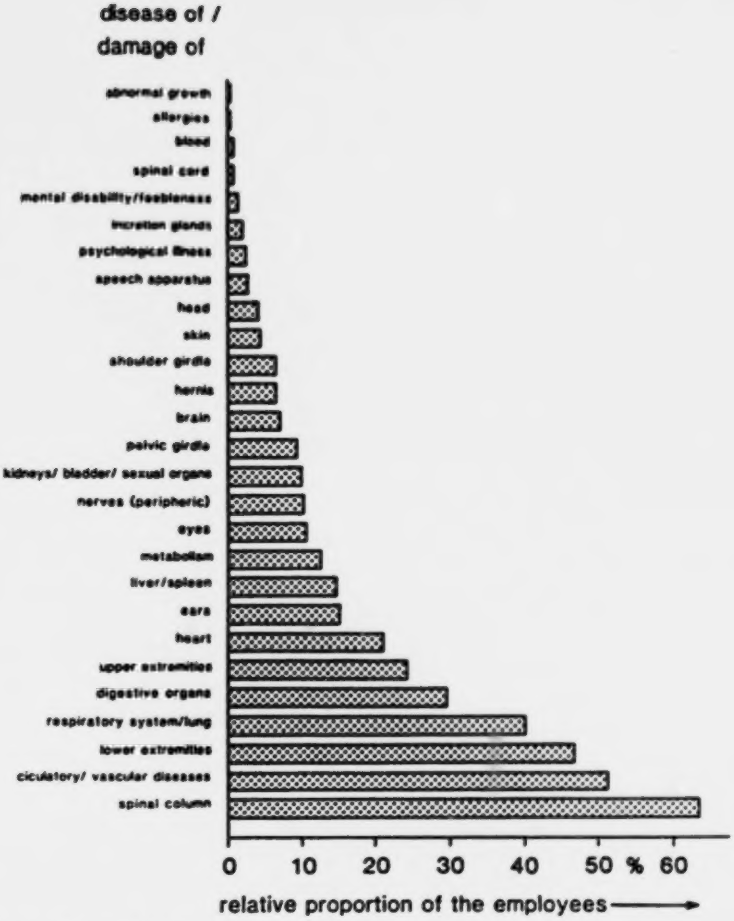

Figure 2: *Distribution of the disabilities*

Silicosis, which affects 23 % is reported most frequently here. Damage to the digestive organs occurs in 29 % of all cases, including 23 % who report diseases of the stomach. Impairments of the upper extremities account for 24 % of cases and most frequently involve damage to the elbow joint. Heart damage is reported by 20 % of the sample. Impaired hearing is next in frequency. Finally, 14 % mention diseases of the liver or spleen, and 11 % metabolic disease, above all diabetes. These are the ten most frequently found disabilities in the sampe studied.

4. Determination of disability combinations

Combinations of characteristics can be determined in principle with the help of analysis of configuration frequency and factor or cluster analysis. All three procedures provide a so-called "posthoc" classification, i. e., an initially unordered amount of objects (disabled persons) as described in terms of various characteristics (types of disability) is divided up into groups which as far as possible are homogeneous. The structure of the class is unspecified and results only from the classification. Analysis of configuration frequency (cf. for more details in this connection Lienert & Krauth 1973; Krauth 1980; Lindner 1984) make the stricter assumptions in the identification of classes with homogeneous characteristics, since they not only – as in the case of factor and cluster analysis – presuppose "similarity" but rather "identity" in the respective characteristic patterns. However, it has the disadvantage of requiring a relatively extensive random sample, the size of which should amount to at least five times the number of all possible characteristic combinations, that is to say $5*2^n$ (whereby n = number of characteristics). Restrictions regarding the permissible number of characteristics therefore result when carrying out analyses of configuration frequency; a maximum of seven different types of disabilities could have been examined for the present sample of N = 1319 persons. Owing to the inherent limitations, application of this method does not appear sensible for the question in hand.

The application of a factor analysis is, however, also problematical since the types of disabilities per working person are described in binary terms, that is to say, on the basis of one of two possible alternatives such as "given / not given" and the measurements available to date for the calculation of the correlative dependencies of binary variables, such as the phi-intercorrelation (cf. Bösser 1979) do not provide optimal estimations, especially in cases where the characteristics under examination occur only rarely. Although a measurement has been suggested in the form of the Yule coefficient as corrected by means of the zero field (Lienert & Sporer 1982), which avoids the weaknesses of the four-fold phi-correlation, it leads to difficulties in the assessment of the factorial loads which cannot be interpreted here as the correlation of the binary characteristic with the hypothetical factor. Determination of the disability combinations was therefore effected by means of cluster analysis. Before this is carried out, however, it must first be established

(a) which characteristics of the object are to be considered in the classification,

(b) by which measure the similarity in the objects is to be recorded, and

(c) which algorithm is to be used for creation of classes.

4.1 Selection of the characteristics

The selection of the characteristics is above all oriented towards two criteria: binary characteristics, which were only classified as "given" in less than 5 % of the cases, were not considered further since it has been shown that they contribute only little to the separation of the classes (Vogel, 1975). In addition, the characteristics applied should be, as far as possible, independent of each other, i. e. should correlate only moderately with each other. High dependencies resulting in part (up to 0.9) in the correlation analysis carried out made reduction of the number of characteristics necessary. To date, however, there are no procedures available for the elimination of the correlative dependencies of binary characteristics. The attempt was therefore made to combine similar characteristics on the basis of given logical connections existing between the individual types of disability. For example from the medical point of view, there are connections between functional limitations of the lower extremities and those of the hip joint. The upper limit for the individual correlations determined to be still permissible here amounted to r = /0.3/.

Table 1 shows the characteristics areas obtained as a result of this as well as the respective correlative dependencies existing between them. The coefficients of correlation, which altogether vary within a range between r = 0.002 and r = 0.273, all fall below the established maximum limit. Figure 3 shows the distribution of the remaining 13 characteristics as related to the total population. Compared with Fig. 2, the order of the individual characteristics has been maintained to a large extent, so that it can be assumed that no alteration to the inner structure of the data has occurred as a result of the characteristic selection process.

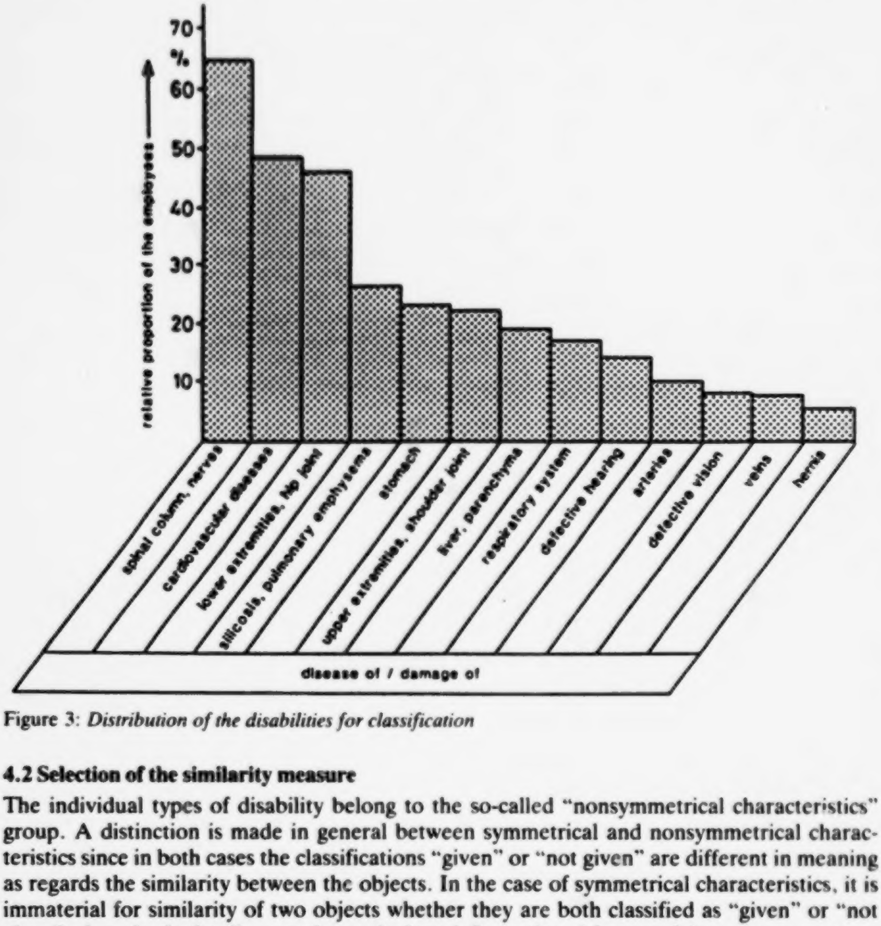

Figure 3: *Distribution of the disabilities for classification*

4.2 Selection of the similarity measure

The individual types of disability belong to the so-called "nonsymmetrical characteristics" group. A distinction is made in general between symmetrical and nonsymmetrical characteristics since in both cases the classifications "given" or "not given" are different in meaning as regards the similarity between the objects. In the case of symmetrical characteristics, it is immaterial for similarity of two objects whether they are both classified as "given" or "not given" since both details contain equivalent information (characterizing two persons as "male" or "not male" therefore implies that they do not differ from one another as regards the characteristic gender since they must both be either "male" or "female"). The situation in the case of nonsymmetrical characteristics is different, however: here, the detail "not given" does not permit conclusions to be drawn as to the similarity of the objects (it is, for example, not possible from the statement that two persons speak "no English" to conclude which language they actually have command of). According to this division, the individual types of disability therefore belong to the group of "nonsymmetrical characteristics" since establishing that two persons do not have one type of disability leaves open the question of the characteristics in which they are similar to each other.

The similarity between two disabled persons can therefore only be established on the basis of the respective "given" types of disability. An appropriate measure of similarity should

disease of / damage of													
1 upper extremities, shoulder joint	2 spinal column, nerves	3 lower extremities, hip joint	4 defective hearing	5 defective vision	6 cardiovascular diseases ●	7 arteries	8 silicosis, pulmonary emphysema	9 respiratory system	10 stomach	11 liver, parenchyma	12 hernia	13 veins	
—	.049	.068	.097	-.038	-.150♦♦	-.100	.043	-.081	-.117♦	-.062	.087	.069	1
	—	-.092♦	.101	-.016	-.018	.108	.120♦	.060	.125♦	-.161♦♦	.028	.044	2
		—	.082	-.013	-.185♦♦	.039	-.123♦♦	-.125♦	-.101♦	-.200♦♦	-.022	.138♦	3
			—	.161♦	-.046	.015	.073	.008	.002	-.077	.125	-.032	4
				—	.040	-.017	-.123	.024	-.091	.127	.013	-.118	5
					—	.075	.080	.011	-.052	.114♦	.099	-.019	6
						—	-.140♦	-.085	-.070	-.125	.026	.244♦♦	7
							—	.065	.002	-.093	-.087	.109	8
								—	.059	.047	.139	.042	9
									—	.048	.007	.036	10
										—	.206♦	.078	11
											—	.273♦♦	12
												—	13

● heart diseases:
muscular heart disease
cardiovascular disease

circulatory diseases:
aterial hypertension
cardiac/circulatory insufficiency

♦ significant for $\alpha = 0.05$
♦♦ significant for $\alpha = 0.01$

Table 1: *Correlation of disabilities*

therefore place more emphasis on the respective "given characteristics" than on those which are "not given". Calculation of the similarities existing between the disabled persons was therefore effected by means of the so-called "S-coefficient", in which the respective "not given characteristics" shared by two persons are not considered.

$$S_{jk} := \frac{d_{jk}}{p - a_{jk}} = \frac{d_{jk}}{d_{jk} + b_{jk} + c_{jk}} = \frac{1}{1 + (b_{jk} + c_{jk})/d_{jk}}$$

p: Number of given characteristics
ajk: Characteristic not given for both object j and k
bjk: Characteristic not given for j, but given for object k
cjk: Characteristic given for j, but not for k
djk: Characteristic given for both objects

4.3 The procedure for creation of classes

The classification itself was carried out according to the "complete linkage" method. This technique belongs to the group of "hierarchically agglomerative" procedures. These procedures are in general characterized by the fact that in each case, "higher" classes arise from the combination of "lower" classes, and that only those objects or classes are conjoined which are similar to each other to a maximum degree (Vogel, 1975). The creation of classes, specially according to the method of "complete linkage", is carried out in such a way that, progressively for all possibles pairs of classes, the two most dissimilar objects are determined in each case, and fusion is effected between the two classes for which this dissimilarity is minimal (Bock, 1974; Vogel, 1975).

4.4 Representation of the results of this classification

Table 2 shows the results of the cluster analysis. Represented here are the 22 most frequently occurring disability combinations as they occurred on the "lowest level" of the class hierarchy, i. e., on the level of the smallest group dissimilarity. It firstly becomes clear that, of the 13 types of disability, 4 also occur individually, namely damage /disease of the "lower extremities" (N 2), of the "spinal column / nerves" (N 3), of the "upper extremities" (N 18), and of the "cardiovascular system" (N 6). 3 of these 4 disabilities, namely "spinal column / nerves", "lower extremities" and "cardiovascular system", occur simultaneously, but in the majority of cases also in combination with others. A similar picture results from Table 3, in which the most frequent disability combinations are listed in order of the number of diseases / amount of damage occurring in each case: damage of the "lower extremities" occurs predominantly in the group of those persons who on the whole are affected by a single disability. "Spinal column / nerves", "lower extremities" and "cardiovascular system" are also most frequently involved in all further combinations (from two to a total of six disabilities occurring jointly).

disease of / damage of	number of disabilities n, disability combinations N_i and extent of random sampling						
	1	2	3	4	5	6	6
	N_2	N_1	N_5	N_{17}	N_{23}	N_{24}	N_{25}
	40	44	29	12	5	3	3
upper extremities, shoulder joint				●	●	●	●
spinal column, nerves		●	●	●	●	●	●
lower extremities, hip joint	●	●		●	●	●	●
cardiovascular diseases			●	●	●	●	●
silicosis, pulmonary emphysema			●		●		●
respiratory system						●	●
stomach						●	

Table 2: *Most frequent disability combinations dependent on the number of diseases / cases of damage occurring in each case.* (The digits (1 . . . 6) in the upper line indicate the number of disabilities. The abbreviations (N_2 . . . N_{25}) in the line below signify disability combinations. The size of the random sample is indicated in the lower line.)

5. Discussion of the results

Analysis of the data obtained by the survey carried out confirms that less visible damage, such as changes to the spinal column or cardiovascular diseases, comprise the majority of the disabilities present. With the help of cluster analysis it was possible to establish disabilities in combination with each other: it was revealed in particular that damage / disease of the "spinal column", of the "lower extremities" and of the "cardiovascular system" were present in almost all disability combinations identified. There are three essential aims which can be deduced from this in terms of measures relating to the planning and design of work: they should

disease of / damage of	disability combinations N_i and extent of random sampling																					
	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_{10}	N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	N_{17}	N_{18}	N_{19}	N_{20}	N_{21}	N_{22}
	44	40	37	35	29	25	21	19	18	18	17	17	15	13	13	12	12	12	10	10	10	10
upper extremities, shoulder joint									●	●				●			●					
spinal column, nerves	●		●	●	●		●			●	●	●	●	●	●	●	●	●	●	●	●	●
lower extremities, hip joint	●	●		●						●	●						●	●	●	●		
defective hearing																				●		
stomach												●						●			●	●
cardiovascular diseases				●	●	●	●	●				●	●				●		●	●	●	
liver, parenchyma								●								●						
silicosis, pulmonary emphysema					●						●				●				●		●	●
respiratory system													●									

Table 3: *Results of the Cluster Analysis.* (The abbrevations (N 1 . . . N 22) signify disability combinations in numerical order according to the size of the random sample groups, which are indicated in the line below.)

(a) lead to making work easier in general

(b) result in a reduction of unfavourable postures, as well as

(c) facilitate physical movement.

This, though, has to do less with diability-related tasks than with those of ergonomic planning and design. As far as the adaptation of workplaces is concerned, this means that basic ergonomic provision at the workplace, supplemented where necessary by planning and design relating to disability, leads to workplace planning and design appropriate for disabilities (Wieland 1984). Furthermore, the advantage of a workplace which has been adapted to a disabled person through the application of ergonomic planning and design measures, lies in the fact that such a workplace can also be occupied by a non-disabled employee.

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Anxiety in patients with brain injuries – Rooming-in with close relatives as a therapeutic approach

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Patients with brain injuries pose numerous surgical, neurological and medical problems. Usually they require intensive care to support their vital functions, many of them need artificial respiration. Later, while the patient is regaining consciousness, additional psychic and neuropsychological problems arise.

Biological rhythms like sleep-waking are disturbed, and the patients lack orientation. Sometimes they are restless, excited or full of fear. This restlessness and anxiety very often are quite striking. It is tempting to treat the symptoms with sedatives or tranquilizers. From the point of rehabilitation, this procedure can however not be recommended. Any drug acting upon the central nervous system may suppress all other functions of the brain, too. It thus becomes difficult to mobilize or reactivate a patient.

In order to cope with fear and anxiety in patients with brain injuries, we have tried to create an atmosphere of comfort, confidence and calmness. For several years now, we have incorporated the method of rooming-in in our concept of treatment. Together with the injured patient, a close relative is admitted to the hospital, i. e. father, mother, spouse, some other member of the family, or a close friend. The patient is not only surrounded by doctors, nurses or other medical personnel, but has a close relative by his side with a well-known face, a familiar voice, or the tender touch of a hand. Furthermore, the familiar atmosphere can be improved by furnishing the room with personal items of the patient, a poster on the wall, a favourite toy, a well-known lamp, or an instrument the patient loves most.

During the last five years we have treated 52 patients (adolescents and adults) with brain-injuries using the rooming-in concept. The age of the patients ranged from 13–68 years (average 24 years). In most cases it was necessary to have the relatives stay for periods of 2–4 weeks. In single cases the presence of relatives was needed for 7–10 days only. In three exceptional cases (patients with apallic syndrome or with severe brain-injuries with protracted courses), relatives stayed in the hospital for periods of 60, 130, and even 180 days. Problems regarding organisation, or economical questions had been clarified earlier with the hospital administration and the insurances.

Since using the method of rooming-in, we have almost completely avoided the use of tranquilizers. Termination of rooming-in depended on the recovery of the patient. When he had regained orientation, and fear, anxiety, and restlessness been overcome, the relatives were asked to withdraw gradually. In some cases it even became evident that, at a certain stage, the continuous presence of relatives made it more difficult for the patient to reach self-support and to become independent.

In every case of rooming-in, it was necessary beforehand, to instruct the relatives carefully. Very often, they needed to be convinced that they were not being admitted to nurse the patient, or to assist the medical treatment. It was, however, most welcome if relatives could assist the nurses, e. g. with feeding or caring for a patient. Also, relatives needed continuous advice and guidance during their stay in the hospital. Many of them later realized that, during this period, they had become familiar with many problems arising with a severely handicapped person.

In some cases, rooming-in with close relatives had to be interrupted as the relatives could not endure the physical and psychic stress involved. To avoid such "failures" we have developed a questionaire, and before starting the rooming-in, the relatives of a prospective patient are asked a number of questions and introduced into all problems expected to arise. If possible, the relatives were asked to come to the ward and shown a family conducting the rooming-in already. Usually these contacts proved to be very successful as they could exchange their problems and receive all kind of information.

The method of rooming-in has been practised in pediatric hospitals for many years; in obstetric hospitals, it has become a routine approach. We found rooming in with brain-injured adolescents and adults to be a valuable method. It enables the patient to regain orientation and overcome his fear and anxiety more rapidly. The problems arising from the organisation of hospital routines and any additional financial burdens are by far outweighed by the advantages for the patient with a brain injury.

Importance of vocational and social reintegration for the maintenance of therapy success with alcohol addicts

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– Abbreviated version –

The predictors for treatment success play an important role in literature. To find out more about that, we started a multivariate global analysis of follow-up data. In a pilot study it was examined whether the factors on which the inpatient facility has hardly any influence, are as closely related to treatment success as was assumed, and whether the differences between the inpatient facilities, the case histories of the patients and their intake symptoms and social background correlated less with success of therapy than the post-treatment factors of "aftercare conditions" and "social and professional living conditions".

The study did not aim at verification of detailed hypotheses. By demonstrating evidence of functional associations, the study was intended to develop detailed, causal hypotheses, and to yield tentative conclusions concerning the realization of addiction therapy under unfavorable social conditions. The present study aimed at replacing the hitherto insufficient work on the evaluation problem in follow-up studies ("What is the significance of a reported rate of efficiency and which practical consequences should it entail?") by an alternative solution, proposed within the framework of the possibilities offered by a retrospective follow-up study. The goal is to supply a rational and transparent basis for the comparison of efficiency rates in different inpatient facilities, by collecting empirical information on the reasons for different success rates of the inpatient facilities under examination. This point of view implies that the factor "inpatient facility" represents only one of the many independent variables that determine "abstinence". Systematic influences on treatment success are taken into consideration. These influences could be an indirect result of the differences in clientele that one might find in an inpatient facility at different times, of other component parts of the therapeutic chain, and similar factors.

This study is based on a retrospective follow-up survey. Its special characteristic is that it was carried out in the same manner at five special inpatient facilities for alcohol and drug addiction, which differed on a number of important points such as the length of the

Table 1: *Variables of the survey questionnaire arranged according to the groups of characteristics*

1. Demography
- Sex
- Age
- Marital status: single/widowed; married; separated/divorced
- Education: intermediate school; secondary school; matriculation standard
- Occupational training: none; completed apprenticeship; completed technical or trade school; completed university studies
- Unemployed at the time of treatment implementation: yes – no
- Occupational status: unemployed; unskilled worker; medium level; upper level

2. Case History
- Type of drug: alcohol; others
- Duration of addiction
- Treatments to cure addiction preceding inpatient facility: yes – no

3. Length and end of treatment
- Modality of release: regular; irregular
- Length of stay

4. Interventions after the treatment with possible therapeutic effect
- Outpatient treatment: yes – no
- Self-help-groups: none; AA; other
- Participation in the group: none; irregular; regular
- Distance to inpatient facility (different postal codes)

5. Social and professional situation after the treatment (objective conditions)
- Unemployed at the time of the inquiry: yes – no
- Living together with other persons: yes – no
- Housing situation (scale)
- Change of residence: yes – no
- Change of employer: no job up to the present; no change; change
- Income (scale)
- Recreational activities: yes – no
- Life companion: yes – no
- Same life companion as before the treatment: yes – no
- No answer to this question: yes – no

6. Hospital
- Patient is registered in a hospital

7. Social and occupational situation after the treatment (subjective scale)
- Stress at work
- Financial problems
- Satisfaction with recreational activities
- Stress in the family
- Number of friends
- Stress caused by the relationship with friends
- Physical complaints
- Emotional stress

treatment and therapeutic approach. All patients were included who had been released from the respective clinics during an average 18 months interval previous to the keydate of the inquiry (Oct. 1, 1982). Table 1 shows the variables of the survey questionnaire. A multiple evaluation method, the hierarchic multiple regression, was chosen for evaluation with regard to the criterion of "abstinence".

Validity of the results is limited to the sample and the instrument of inquiry used here, to the variables adopted for the evaluation, and the method chosen for the grouping of characteristics and the setting up of the hierarchy.

The four most important results were as follows (for details, see Waldow, 1983):

1. The correlation between the factors "demography" and "case history of the addiction" and the abstinence criterion failed to reach statistical significance. This finding does not support the assumption of clinicians that case history is of great importance for predicting treatment success. It also does not concur with the results found in literature about the significance of demographic variables. Only a prospective catamnesis, which includes more detailed and more reliable data concerning these two factors, could help clarify these contradictory findings. The 2,2 % common variance of "demography" and the success criterion can essentially be traced back to the variable "unemployed at the time of entering treatment".
2. When taking into account the differences between the different sets of characteristics, the differences between the inpatient facilities no longer yield statistical significance. This result corresponds with the findings in literature (Emrick, 1975; McGuire et al. 1982; McLellan et al., 1983). Only if specific patterns of change for each individual inpatient facility (Grawe, 1978) are considered, could evidence of specific effects of different treatment centers be expected. It must be taken into account that the percentage obtained does not demonstrate inpatient treatment to be less efficient than other types of treatment, as the present findings merely examined the correlation between the differences among the inpatient facilities and the success criterion. To support a causal hypothesis, a completely different type of evaluation research would be necessary. Such research would require use of a controlled treatment design that systematically varies clinic factors, holding constant such other factors as patient population etc.
3. The study showed that there is a close and statistically significant correlation between the criterion "abstinence" and any interventions after inpatient treatment that provide a possible therapeutic effect. This highlights the importance of optimal aftercare, as well as of a stronger and better linkage of the different parts of the therapeutic chain for increasing abstinence rate.
4. The social and vocational situation after treatment has the greatest influcence. The correlation between this factor and abstinence shows a strong statistical significance. Statistical significance is also reached by the subjectively perceived state as a result of the social and vocational situation after the treatment.

Conclusions

The conclusions drawn from the results of this study can best be based on the following principle of interpretation: A statistically significant and large variance portion allows us to draw the conclusion (although not in the sense of a logical deduction; see Perrez & Patry 1982) that an optimal position in a particular set of measures leads to an expectation that the abstinence rate could be increased. On the other hand, a low and statistically not significant variance portion does not permit any conclusion concerning the possibility or necessity of improvements in the particular field. If this rule is accepted, the following suggestions for improvements in therapeutic practice can be derived from the results:

1. Improvements of the aftercare and in the field of the general living and working conditions (job, home, social relationships, recreational activities) are essential and promise to contribute toward an increase of abstinence rate. The effect of aftercare or outpatient follow-up treatment was shown in several studies (Costello, 1980; Vannicelli, 1978). However, in view of current socioeconomic conditions, a drastic reduction of the abstinence rate can be expected in the near future, becauses the socioeconomic variables, though critical for longterm therapeutic success, are not subject to manipulation by psychological or therapeutic methods. As far as aftercare is concerned, increasing attention should be given to the role of various supportive measures for the unemployed.
2. Better coordination of services by agencies that make up the therapeutic chain probably would increase the abstinence rate.
3. Improvement of the abstinence rate is likely to be achieved by an intensified program of aftercare. An individualized training program for use of recreational opportunities must take place, and those skills must be developed in a systematic manner which enable the patient to exercise control over his own life situation (e. g., efficient search for employment, maintenance of social contacts). Furthermore, the patient must be helped to cope more effectively with unemployment, to reduce overall psychological stress. To accomplish these goals, a reallotment and restructuring of institutional funds and personnel will be required.
4. Therapeutic efforts with relatives during inpatient therapy must be intensified particularly for unemployed patients, for ex. through family therapy programs, and outpatient aftercare must include family therapy for maximum effectiveness.
5. Inpatient therapy, particularly the longterm therapy of 5–6 months duration, should not only be better integrated into the therapeutic chain, but should also be coordinated as to timing and contents with both outpatient preparation prior to clinic admission and the outpatient aftercare.

Further guidelines on this topic could be developed from the results of prototype institutions. Some inpatient facilities are linked to outpatient facilities located in their catchment areas. Some personnel in the inpatient and the outpatient facilities were also rotated in correspondence with the date of the patient's discharge from the inpatient facility. A new approach, called interval therapy and introduced by Schneider (1984), appears to be very promising. In this program, treatment supports for a stabilisation process in the community extend over a two-year period, with intervals between repeated inpatient stays being gradually extended

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Methods of changing the social environment

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Handicap and social environment – definitions

At this International Rehabilitation Conference, we are dealing with the problems disabled or handicapped persons have in their life situations. In this group, we will mainly discuss social aspects. I will start my presentation by defining the two concepts "handicap" and "social environment".

A situation of handicap arises when the demands made of a person more permanently exceed his capacity. It is thereby clear that the degree of handicap depends not only upon the person's capacity, but also upon the range and magnitude of the demands made of him by society, the environment, the people around him, or the disabled person himself.

In the concept of social environment I include the physical and interpersonal conditions which are of importance for personal development and maturity. The goal for the development of a person, especially a person with some disability, is to help him achieve harmony with life and let him feel secure in his situation.

Although all physical and interpersonal relationships can be included in the concept of social environment, it is often useful to distinguish between the person's "personal environment", i. e. his home, relatives or close friends, and the "general environment", comprising society as a whole. One of the practical reasons for separating the two kinds of "social environments" is that the methods of changing the situations of persons with disabilities are quite different in the two cases.

All too often, we look upon the environment as a static situation. The title of the theme for today's discussion also expresses that view. We forget that the interaction between a person and his environment changes the person as well as his environment. This process never stops – the question is in what direction the process is going, and how fast. The objectives of the process, the prerequisites for starting the process, and the support needed to maintain the process must be taken into consideration when we are talking about changing the social environment.

Changing the personal social environment

Medical rehabilitation is mainly concerned with helping the disabled person to improve his physical function by treatment and training. This is of course very important. But Doctor Howard Rusk points out that we are successful in our rehabilitation only when we can give a positive answer to the question whether the disabled person has:

- somewhere to live, a home;
- someone who loves him and takes care of him;
- something to do, a job, and
- leisure activities.

The problems in the social environment of the disabled person in relation to these question have to be solved in different ways for each disabled individual. The rigid bureaucratic organisation of the social welfare system very often reduces the possibilities of helping the disabled. Too many civil servants are involved in the decision process. In a three-year research study, we analysed the results of designing a system whereby every disabled person has his own "ombudsman", who supports him and is involved in his total situation. The ombudsman helps the disabled person to coordinate the different resources, regardless of what kind of service it is. Our investigation shows that this "personal contact system", designed according to the needs of the disabled person, was far more efficient than the traditional system based on specialisation. The personal contact system was not only more efficient in arranging housing services and jobs for the disabled, but also made them feel secure and satisfied. The system means that the disabled person has to utilise his personal resources to achieve freedom and independence, and has to take responsibility for his own life.

The most efficient way of changing the social environment for the disabled person is to give him a chance to live a real life. This can only be achieved if we are willing to trust him and let him take responsibility for his own life. From the large-scale independent living experiment, the Fokus project, which has been going on in Sweden for the last 15–20 years, we have found that a social welfare system which can offer the disabled person his own home and suitable home-help and transport service is necessary if the disabled are to be able to take part in the social activities of society.

The results of our research also show that a social welfare system designed in that way will not only be a means to freedom and independence, but will also help the disabled person to develop his personality and maintain his identity. To achieve the goal of giving the disabled person a social environment in which he can live as normal a life as possible, we must accept him as a full member of society.

In medical practice, doctors and nurses are very active in looking for the lost functions. In the rehabilitation sphere, we must analyse and utilise the capacity the disabled person possesses. We must not forget that disabled persons have a lot of abilities left. But they also have their experience of being different from others, very often isolated and understimulated.

I would summarise the ways in which we can help to change the personal social environment for a disabled person as follows:

(1) We have to learn that social justice helps – sometimes more than medical treatment.

(2) The disabled person needs a personal adviser (ombudsman) who can help him to find the right solution to his problems, help him to establish contact with the right authorities and help him to coordinate different resources.

(3) The basic needs for living and social contacts, i. e. a home, transport service and telecommunication (for blind and deaf persons), must be offered to the disabled.

(4) We must all be ready to accept and respect the handicapped person and accept his disabilities.

(5) We must utilise the special abilities each disabled person has.

Changing the general social environment

When discussing the general social environment, it is most practical to use the organisation of our society as the starting point. I will deal with some of its main aspects.

Building and townplanning in the long run is very important for the social environment. In 1974, a non-governmental expert group appointed by the Commission of the European Communities presented detailed recommendations for accessible buildings and usable dwelling. In this work, the requirements of disabled persons were presented as well as ways to adapt the built environment to everybody's needs. The problem is thus not a lack of knowledge of what to do but a lack of political will or ability to make the right decisions. To have the recommendations accepted as law in Sweden in 1978, we had to show that the new building standards were of importance not only to the disabled but to many people – all of us will become elderly and have trouble climbing stairs. We also had to demonstrate that the new norms will reduce the need for home-help service and institutional care. We also showed that the production costs for a well-designed new dwelling are about the same as for dwellings of the earlier standard.

Home-help service and personal assistance is of great importance in order to enable the disabled person to lead an acceptable life. To avoid being like an institution, home-help service must be given on the terms of the disabled person. The best way is to give the disabled the economic support they need to take responsibility for their own service system. In all our investigations on home service systems, we found that service systems based on hospital or nursing-home models are inferior to a service where one and the same home-help is assigned to take care of one or several disabled persons for one or more hours per day or week, combined with a day-and-night "helping-hand service".

Technical aids are necessary to help disabled persons to increase their freedom and independence. They also reduce their need of assistance. It is quite obvious that providing the disabled with technical aids is an important task for society, whether the disabled person has to buy the aids himself or, as in some countries, he is given them free. Whatever method of support is used, it is important that the disabled himself is involved in the selection of the aids. Another important point is that the aids must be thoroughly tested, and an efficient repair service must be available when the aids are broken.

Transport services for disabled peoble must be looked upon as part of the public transport service. The disabled person has the same need and the same right as everybody else to visit relatives and friends and to participate in cultural activities. A transport system is necessary if the disabled child is to be able to go to school, the adult to go to work, etc. It is especially important for children and youngsters to have a chance of changing their social environment by getting out of their homes and making new experiences. This will broaden their outlook and help them develop their personalities.

The educational system for the disabled has improved during the last decade in many countries. One of the reasons for this is that there is a trend towards integration of disabled children in ordinary schools. This is an important step forward. But we must not overlook those pupils who cannot attend an ordinary class. It is important that the educational system also includes opportunities for these children who need individually adapted education. Another important point is that the school must strive to prepare the disabled child for his future life, and not only give him knowledge he will never have a chance to use. On the other hand, we must offer supplementary education to disabled persons.

Labour market problems for the disabled must be dealt with in a very serious way. Adaptation of the workplace, and provision of personal assistance and technical aids for the disabled at work are tasks not only for the employer but for society as a whole. In one way or another, the authorities must provide economic support for those who employ disabled people and have to make extensive adaptations or provide extensive assistance. I particularly like the special support that is sometimes given to individual disabled persons to help them to start their own business, perhaps together with other people.

Economic and insurance support is important in order to enable the disabled person to live. The way in which the disabled person receives this economic support has a great influence on his self-confidence and sense of independence. Nobody likes to receive charity.

Changing people's attitudes and our own view of human dignity – the only way to change the social environment

My brief presentation of areas in which we can change the general social environment can be looked upon from a technical and a psychological point of view. Legislation and government recommendations are necessary. But laws will never be effective if they are not based upon public opinion and attitudes. The best way to start changing the social environment is, therefore, to change people's attitudes. We must stop separating the population into "the disabled" and "us", the non-disabled. We must accept the disabled as full members of society.

If we are to have a chance of changing people's attitudes, we must start by changing our own feelings towards the persons with a disability and having more respect for human dignity. Nobody working in medical care or among the disabled can avoid the existential question of human dignity. In all our work, we must respect the disabled person and his views. We have no right to dictate what the disabled person must, or must not, do. We are servants, and our task is to help the disabled to find their own way in life. As specialists and people with some influence in society, we must use our abilities to change people's attitudes and increase their respect for human dignity even when the human spirit is enclosed in a disabled and imperfect body.

Disability and the built environment

J. Buchanan, Birmingham (United Kingdom)

Introduction

Handicap is largely determined by the interaction between personal disability and the local physical environment. Controlled studies (1,2,3,4) carried out in the last ten years in urban and rural areas in the UK and Holland have identified many of the mobility problems of physically disabled people in relation to the built environment. The aim of these studies was to look at what features of the physical environment cause problems for physically disabled people; what proportion of physically disabled people have restricted mobility as a result of these environmental features, and what effects this restricted mobility has on their ability to carry out everyday activities.

Changes over the last decade

Since these surveys were carried out there have been a number of improvements that have been made in the design of the built environment and transportation facilities – many as a direct or indirect result of legislation.

This paper attempts to identify some of the improvements that have taken place since these studies were carried out, and to list those problems which still exist. It finally looks briefly at some solutions to the remaining problems.

Starting with the problems that were identified in the original studies, there were several features of the environment which limited mobility on foot. Uneven and slippery surfaces, steps and steep slopes caused most problems, but over half of the disabled people also had trouble negotiating kerbs and crossing roads.

Improvements have been made in various parts of the UK in all these areas. Most housing still has at least one step from the door to the street, but there are now grants available from the Local Authority to either put up a hand-rail for ambulant disabled people, or to provide ramped access, where necessary. More thought is given to the design of steps in the environment. In many new designs, a ramp is provided as an alternative to steps. In many towns in the UK kerbs have been dropped at major road junctions, and more controlled crossings have been established. On many busy, wide roads central reservations have been provided where disabled people can pause to take a breath half-way across a road.

As regards public transportation, the studies found that less than a third of the disabled people were regular users. Since that time, a number of flexi-bus schemes have been introduced in different parts of the country, which take people from their home to their destination. There is also a new bus design produced by British Leyland which has a lower entrance step. In South Yorkshire there are "kneeling buses" which make access much easier. Mainline trains in the UK have been designed so as to permit wheelchair users to travel in the main part of the train rather than in the guard's van. There are ramps available on request at each main station for easy access. On both tube trains and buses, seats nearest to the doors have been allocated for disabled people.

There have been a number of improvements to private transport, too. Many more adaptations are available for cars, and new cars, such as the Elnswick Envoy, have been designed specially for wheelchair users. Parking places have been designated for disabled people next to the exit of car parks and near to the entrance to shops and public buildings.

In many areas, shops and public buildings have been made more accessible. Supermarkets usually have automatic doors and flush thresholds for easy access. Most newly designed public buildings have ramped access for wheelchair users as an alternative to steps.

Problems which still exist

There is no doubt that there have been considerable improvements in the design of the built environment. We see many more disabled people out and about, either in wheelchairs or with mobility aids. However, despite all these improvements, many problems still exist for physically disabled people. The built environment is still far from perfect.

Much of the housing stock in the UK is old and has at least 5 steps to the street. Many people do not know that it is possible to obtain adaptations for easier access, either a ramp or a handrail, from the Local Authority. Physical features in the environment have often remained unchanged in the older areas. There are still many areas where no ramped alternative to steps is available. In the country areas, high kerbs still predominate. There are also many busy wide main roads where no central reservations to help in crossing roads exist, and lights at controlled crossings do not allow time for a disabled person to cross the road in comfort.

In the field of transportation, although buses with a lower step have been designed, very few are in use throughout the UK, and flexi-buses are available in very limited areas only. Seats specially designated for disabled people near to the door in buses and on tube trains are often occupied by able-bodied people who do not readily give up their seat for someone else. Many disabled people do not know that ramps are available to help in boarding trains. There are still many oldstyle trains in which wheelchair users have to travel in the guard's van.

Society generally relies more and more on private transportation, and this has resulted in the closure of many village and corner shops, but disabled people remain a low car-owning group. They therefore often face difficulties in reaching even the nearest shops, which are often more than half a mile away from their home.

The major part of the built environment in the UK was designed at least forty years ago, and numerous shops and public buildings remain inaccessible to many disabled people. Inside shops, the ground floor is often the only part of the building which is accessible to disabled people. Many disabled people are therefore unable to do their own shopping, and have to depend on others to go to the chemist or to the post office for them to collect their medicines and pensions. The original surveys all showed that disabled people had much less contact with other people and went out much less frequently than their able-bodies counterparts.

Conclusions

There is still a long way to go before the built environment is free of physical barriers for disabled people. The Dutch surveys suggest that it will take even longer for many disabled people to overcome the psychological barriers. Education of the professions and the public is of key importance. Physically disabled people need to know what services are available, what aids are available, and which places are accessible. Professions treating disabled people need to be fully aware of the problems that physically disabled people encounter outside hospital – in the community.

More general awareness by the professions designing the environment has led to some improvements. This process must be expanded.

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Group 7:

Pain syndromes

Chair: Prof. Dr. Th. Gerritsen, Hoensbroek, The Netherlands

The understanding and evaluation of chronic pain: Subjective vs. objective determinants of pain

M. T. Hyyppä, Turku (Finland)

1. Introduction

Understanding and rehabilitation of patients suffering from chronic pain is a complicated and demanding task. Chronic pain has social, psychological and somatic dimensions, which are interwoven into the pain problem. The problem or conflict appears as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (IASP Subcommittee on Taxonomy, 1979)

The definition of pain stresses psychological theories of pain. For example, pain can be a reaction towards a threatening damage to the body, similar to anxiety which occurs with a threatening loss of an external object (Szasz, 1957). The affective-emotional component of chronic pain appears as the experience of suffering, which can be described as depression, guilt, anxiety, hostility, and other phenomenological characteristics of chronic pain.

Anxiety together with depression is the most common emotional concomitant of chronic pain (e. g. Engel, 1959; Garron & Leavitt, 1979; Bond, 1981; Swanson, 1984; Ranga Rama Krishnan, et al. 1985), though a high degree of individual variability has been observed (e. g. Linton & Götestam, 1985). In a recent study the relationship between symptoms of anxiety and low back pain was significant (Ranga Rama Krishnan et al., 1985). This observation is in agreement with our recent study about patients with unspecific pain complaints (Hyyppä & Salminen, 1984; Syvälahti et. al., 1985).

2. Pain emotions and chronic back pain

Independent of possible cause, low back pain is related to a complex of various subjective experiences and personality factors. In order to test the signigficance of associations between the experience of pain and psychoendocrine responses, we assessed several clinical and psychological characteristics in a group of patients with sciatica and low back pain. The variables were then related to the blood and CSF levels of prolactin and cortisol, which are known to respond to stressful situations. (The study is part of a comprehensive and longitudinal rehabilitation investigation of back pain patients in the Rehabilitation Research Centre (see Alaranta et al., 1983; Hurme et al., 1983; Hyyppä et al., 1985 a, b; Alaranta, 1985; Hurme, 1985)).

The original investigation consists of 357 previously unoperated patients, aged under 55 years, with sciatica and neurologic signs of rhizopathy. The study was approved by the

Ethical Committee of the Turku City Hospital. The present material consisted of 101 consecutive patients from the original group. Nine of them were excluded due to the drugs taken which probably influence hormonal parameters. Demographic and clinical characteristics of the remaining 92 patients are given in the original paper (Hyyppä et al., 1985 b).

In addition to the above mentioned characteristics of patients, a self-report based rating scale, Symptom Check List (SCL-90), was used to assess anxiety, depression and somatization. It was assumed that high anxiety scores reflect the feelings of uncertainty of living with prognostically unpredictable pain and suffering. SCL-90 rating scales do not refer to psychological abnormalities but rather to the adaptation difficulties in relation to the illness. SCL-90 is also useful for discriminating anxious patients with somatization from those with depressed states (Derogatis et al., 1973, 1975; Prusoff & Klerman 1974). Recent studies on chronic pain have confirmed the usefulness of SCL-90 (Pelz & Merskey, 1982; Duckro et al., 1985); i. e. SCL-90 appeared to offer the best combination of relevant data and efficient assessment of anxiety and depression when compared with several psychological instruments in the clinical evaluation of chronic pain patients (Duckro et al., 1985).

The distribution of hormone concentrations in male and female patients showed sex difference. Prolactin levels were significantly higher in women than in men. This is in agreement with our preliminary observations (Alaranta et al., 1983). A slight but statistically significant sex difference was also observed in the serum cortisol concentration. Men had more cortisol in the blood than women at 4 p. m. of the second day and in the morning when they were subjected to rhizography (Fig. 1).

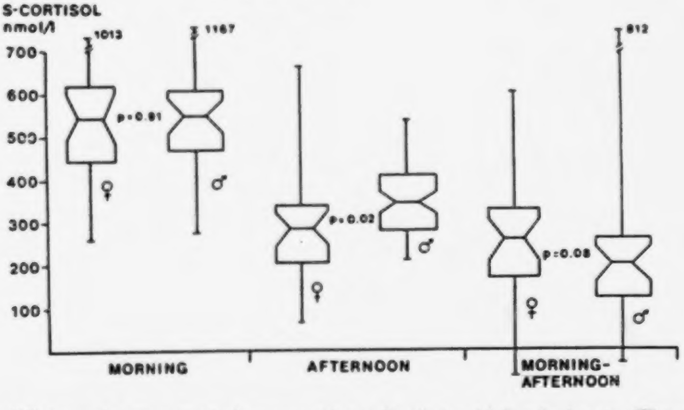

Figure 1: *Sex differences in serum cortisol concentrations of patients with low back pain.* (The results are given in a form of box plots in order to illustrate various statistical measures in one figure. The explanation is the following: The beginning and end of the vertical bar are the respective minimum and maximum of the observations in each category; the bottom of the box is the lower quartile and the roof the upper quartile; the waist line indicates the median of the observations. The approximate 95 % confidence interval is indicated by the narrow-off area of each box. Statistically significant sex difference is seen in the afternoon concentrations of cortisol (p = 0.02; t-test.)

Psychological rating scales of the experience of pain differed according to gender. Women tended to report more emotional symptoms than men. The somatization and depression indices were statistically higher in female than in male patients (Fig. 2).

Multiple stepwise regression analysis was then carried out according to a pre-set plan. Serum cortisol explained only 12 % of the variance in CSF cortisol levels, while serum prolactin

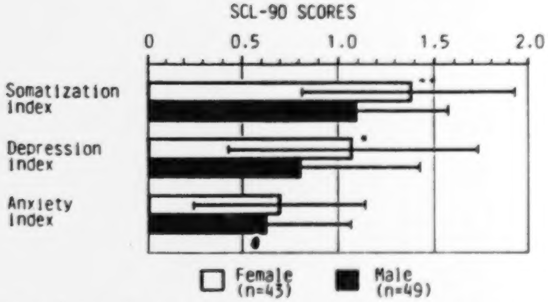

Figure 2: *Statistically significant sex difference is seen in somatization index (**$p < 0.01$) and in depression index (*$p < 0.05$) (two-sample t-test).*

explained 30 %. Among demographic variables, body mass index (weight/height^2) accounted for 9 % of the total variance in the serum cortisol levels, with height being related to a decline in cortisol concentrations. Sex difference and EMG pathology accounted for about 12 and 7 % respectively, of the variance in the afternoon cortisol levels. When sex was taken into account, the degree of depression explained 6 % of the variance in serum prolactin concentrations. Somatization proportion, anxiety severity and index of pain contributed to the variance in CSF prolactin (Tab. 1).

Table 1: *Multiple stepwise regression of hormone levels on various demographic, clinical and psychological factors.*

(An F level of 4.00 is used for further stepping, and only the factors which entered with F 4.00 in the final step are given in the table.
R is the multiple correlation coefficient.
Independent variables in the statistical treatment were age, sex, height, body mass index, pain duration (chronic or acute), pain persistence, disability, impairment and disorder indices of clinical status, indices of pain and ADL, EMG finding, rhizography finding, anxiety (severity index or proportion), depression (severity index or proportion), somatization (severity index or proportion), and pain intensity index. (Hyyppä et al., 1985 b).

Independent variable	Hormone	Increase of R^2 with variable (%)
Body Mass Index	Serum cortisol	8.6
Serum cortisol	CSF cortisol	12
Sex	Serum prolactin	10
Depression %	Serum prolactin	6.4
Serum prolactin	CSF prolactin	30
Somatization %	CSF prolactin	6.7
Anxiety severity	CSF prolactin	3.7
Index of pain	CSF prolactin	3.6
Somatization %	CSF/serum prolactin	9.7
Index of pain	CSF/serum prolactin	8.6
Somatization severity	CSF/serum prolactin	5.4
Body Mass Index	CSF/serum prolactin	5.1
Sex	Afternoon cortisol	12.5
EMG	Afternoon cortisol	7.1
Height	Cortisol decline	11.1

We conclude that in spite of the common underlying endocrine responses to distress in men and women, gender differences in psychological coping strategies appear to modify those responses in the presence of stressful situation. The obvious consequence of this study for rehabilitation professionals is that they should attempt to reduce anxiety and depression of chronic pain patients. Research on coping mechanisms used by men and women in dealing with distress may be helpful in clarifying the relationship between gender and pain experiences (Sowa & Lustman, 1984). The gender differences in coping with distress (like pain) appear to modify results of the rehabilitation programs which include relaxation, psychotherapy, group therapy, etc.

3. Masked depression and chronic pain

Some investigators suggest that chronic pain is a particular variant of depressive illness (see Blumer & Heilbron, 1982). Usually depression is overlooked clinically, but rehabilitation staff, in particular, have sometimes also overdiagnosed clinical depression in patients with chronic pain.

The dexamethasone suppression test (DST) has been used as a biological marker of depression in many research settings (for refs., see Syvälahti et al., 1985). In a preliminary study we found a high percentage of DST non-suppressors among rehabilitation patients who suffered from chronic pain (Hyyppä & Salminen, 1984). This observation led us to expand the population of patients and to cross-check DST findings with other clinical and psychological markers of depression (Syvälahti et al., 1985). Non-suppression of the afternoon serum cortisol test levels on the DST was observed in 24 % of the total group (115) of our patients with unspecific somatic complaints. Among them chronic pain was clearly the dominating symptom. Interestingly, nearly all of our patients reported only somatic symptoms, and at the depression rating scale assessments (Beck Depression Inventory and Hamilton Rating Scale for Depression), depression symptoms were mostly classified as mild. Thus, the patients suffered from atypical or masked depression, not clearly recognized by the patient or surroundings (Syvälahti et al., 1985). Earlier investigations have also shown that anxious patients reported more somatization, while depressive patients reported themselves as more severely impaired on all factor scale dimensions of Hamilton scores, with the exception of the somatization scale (Prusoff & Klerman, 1974).

The degree of somatization varied greatly in our patient group, but there existed a somatization/anxiety factor in Hamilton scores which characterized this group of rehabilitation patients. However, the factor was not suited for the further segregation of sub-groups established with the aid of the DST.

In the light of the present study, the somatization/anxiety factor does not seem to be sufficient in characterizing the possible pain-prone disorder (Engel, 1959; Blumer & Heilbron, 1982). In the rehabilitation setting the DST may, however, uncover masked depression in some, but not in all, patients who report suffering from chronic pain (Syvälahti et al. 1985).

4. Conclusion

Since the nature of pain is multidimensional, evaluation and management of pain patients must also be multidimensional and comprehensive. There exists no single paradigm for the rehabilitation research of chronic pain, but at least three categories of paradigms must be applied, i. e. biological, psychological and socio-cultural (e. g. Bond, 1981). The discriminant power of biological methods (here psychoendocrine) seems to be of minor relevancy to the suffering. Psychological assessments tackle the problem of chronic pain and suffering better, but the reliability of these assessments is still unknown which diminishes their value in rehabilitation research.

In a limited group of chronic pain patients biological measurements may uncover masked experiences. Among patients suffering from chronic pain, men, who usually cannot express their emotions openly, and rehabilitation patients who report only unspecific somatic complaints belong to the above mentioned group.

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Psychological factors in back pain: Self-rated back pain

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– Amended version –

1. Introduction

The need for extensive psychological leads has become apparent when dealing with such a complex issue as back pain. Part of the current interest in studying the psychological factors involved in back pain may be connected to the fact that a great deal of research and advancement has been made on this subject. Nevertheless, the dilemma remains that: "patients with apparently identical pain syndromes tend to respond quite differently to identical treatments" (Turk, Meichenbaum & Genest, 1983).

A good example of the work that has been invested in clarifying the causes of one of the contradictory phenomena of the pain experience, are contributions published in recent years, with the aim of developing a psychological test which could predict the likelihood of pain alleviation after surgery for chronic pain. A connection is assumed between the success of treatment and the psychological state before the operation (Oostdam & Duivenvoorden, 1983; Bouras et al., 1984; Hagedorn et al., 1985). Despite research effort, no significant advances have however been made.

When subjects with functional back pain and *with no organic findings* have been compared to subjects with back pain and *clear organic findings,* the subjects with *no organic findings* have been found to have elevated scores on the Minnesota Multiphasic Personality Inventory (MMPI), on the measures of depression, hypochondria, and hysteria (Sternbach et al., 1973a, 1973b, 1973c, 1973d; Gentry et al., 1974; Calsyn et al., 1976; Freeman et al., 1976; Shachman et al., 1984). In addition, the following attributes have emerged from the use of other psychological tests than the MMPI: findings of anxiety (Violon, 1973; Frymoyer et al., 1980), denial (Blumer & Heilbron, 1981), and high neuroticism scores on the Eysenck Personality Inventory (Taylor, 1968; Woodforde & Merskey, 1972; Jamison et al., 1976; McCreary & Jamison, 1975; McCreary et al., 1980; Frymoyer et al., 1980).

Pain intensity has in general not been correlated with the frequency or degree of change in psychological states. The majority of studies on pain intensity and psychological responses are experimental in nature, e. g. Schalling (1971), although clinical studies are becoming more popular. In a clinical study of pain patients by Shachman et al. (1984), no correlation between mood states and severity of pain was found. However, a positive relationship between pain intensity and depression was found by Timmerman and Sternbach (1976): the patients had rated their pain on a visual analogue scale and were also tested as to their pain intensity by a method of rating pain applying pressure with a tourniquet. All their patients had chronic pain (> 6 months).

The present clinical study was designed to:

(a) replicate, if possible, the results by Timmerman and Sternbach (1976);

(b) to identify other possible connections between pain intensity and psychological parameters.

2. Subjects

Malmö, a center for industry and commerce in southern Sweden, has some 235,000 inhabitants. Patients with minor back problems are usually treated by the district physician, factory physicians, private general practitioners, or by private orthopedists. There is only one department of orthopedic surgery (Malmö General Hospital), where the vast majority of patients with severe back problems are treated and where all spinal surgery is performed. A total of 87 back pain subjects, originating from 3 different groups ot subjects, took part in our study:

Group 1 (N: 46) consisted of subjects from the general population and was obtained by the following procedure: A questionnaire was distributed among randomly chosen inhabitants of Malmö, born between January 1913 and December 1962; males and females alternately. In all, 600 subjects were asked whether they had back pain, and invited to submit to an extensive back examination. The survey response rate was 69 %.* 138 subjects had back pain, and 76 of them were willing to participate in our study. The volunteers were then sent a more detailed pain questionnaire. We were unable to accomodate all of the 76 volunteers in our study due to limited financial resources, and therefore include 46 subjects in this study who had all successfully completed the psychological tests.

Group 2 (N: 24) consisted of light-industry workers with back pain working in a semi-automatic, light-industry factory. In collaboration with the factory physician and workers safety committees, an inquiry was sent to workers known to have frequent back pain. 61 were willing to take part in the examinations, 24 were randomly selected for inclusion in this study.

Group 3 (N: 14) consisted of back pain patients who, prior to a myelography because of back pain, were asked to take part in the examination. Myelographies are performed as a pre-operative measure on patients who are to be operated for disc hernia. However, as myelography is considered to be a rather safe procedure due to new relatively atoxic contrast media, it has also been used rather liberally in the investigation of patients with pain in the legs. 17 patients were asked to take part in the study. 14 accepted and are included. A study of this group's hospital records showed: 2 had clear-cut herniated discs and were subsequently cured by surgery, 3 had clear-cut symptoms and signs of sciatic pain but with negative myelography findings, 5 had sciatic pain without signs of herniated discs, 2 had spinal stenosis, and 1 had pain in most of the body as a consequence of a dental infection.

3. Method

The subjective assessment of pain was carried out by the use of a graphic rating scale which was included in a pain questionnaire. The pain questionnaire has been thoroughly described in Rydén et al., 1985.

All the subjects rated their pain prior to being tested by a psychologist. They thereafter completed a battery of psychological tests, which included: the Eysenck Personality Inventory (EPI); the Meta-Contrast Technique (MCT); the Separation Test; and the Rod-and-Frame Test (RFT). Of these tests, the EPI and RFT are well known. The subjects were instructed to rate the intensity of chronic back pain as experienced by them. The graphic rating scale (GRS) used here for the self-rating of pain is a modified version of the visual analogue scale (VAS) (Huskisson, 1974; Zwetnow, 1979). The reason for the use of the GRS instead of the VAS in this study, is that the GRS has been found to be more accurate than the visual analogue scale (Scott & Huskisson, 1976).

The procedure for rating the GRS was to make a single mark on a 10 cm line, the extremes of which were labelled "no pain" (ingen smärta) to the left and "pain cannot be worse"

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* The remaining persons who had answered a questionnaire on pain but unwilling to participate thought their pain to be negligible or of a mild character. These subjects were either in their twenties or in their seventies. An analysis of their answers is in progress.

(smärtan kan inte bli värre) to the right with the words "light" (lätt), "moderate", (måttlig) and "severe" (svår) at 2.5 cm intervals in between. The exact location of the mark was used as the dividing factor between the levels of pain. The division was done by dividing the subjects into groups depending entirely on their score on the GRS. The GRS was divided into 4 equal parts of 2.5 centimeters each, and the subjects assigned to the part (pain level) which included his/her score.

Initially, the 3 original groups of subjects in this study were analyzed and compared. The comparisons were done by means of chi-square and t-test analyses. However, we failed to find any differences between the groups in this comparison.

Subsequently, new groups were formed based on the individual's pain ratings as described above. Because of the small number of subjects in level 4, 3 subjects from level 4 were incorporated into the level 3 category. The results therefore include only 3 of the original 4 levels.

The Eysenck Personality Inventory is a 57-item questionnaire. The test is easy to administer, takes little time to complete and has a parallel version which allows for retesting. The test is designed to measure two major dimensions of personality, neuroticism/stability and extraversion/introversion. These two bipolar dimensions are regarded to be basic factors of personality (Eysenck & Eysenck, 1964). Neuroticism has been defined as emotional lability, overresponsiveness and liability to neurotic breakdown under stress. The higher the neuroticism score, the greater the degree of emotional overresponsiveness.

The extraversion score shows outgoingness and uninhibited social tendencies of the subjects; the greater these tendencies, the higher the extraversion score (Bond, 1971). Included in the EPI is a lie scale, but the nature of the dimension the Lie scale measures is uncertain. The authors of the EPI test regard the Lie scale dimension as that of "faking good", and they further warn that if the Lie scale score exceeds 4 then the other values for the two main dimensions (the extraversion and neuroticism) should be regarded with scepticism (Eysenck & Eysenck, 1964).

The Meta-Contrast Technique is a modern projective personality test based on psychoanalytic and perceptgenetic theory. The test is designed to cause anxiety (Kragh & Smith, 1970; Smith et al., 1982), whereby the defensive processes used to cope with the anxiety produced may then be studied. It is based on the idea of perceptions being microgenetic. The purpose of perception is seen as the development of stimulus interpretations towards intersubjectivity. The meanings that anteceed correct recognition are generally not conscious but have been shown to be recognizable with the use of a tachistoscopic technique where short-term (milliseconds) presentations of pairs of stimuli are made at increasing exposure times until the stimulus is perceived correctly (Westerlundh & Smith, 1982). The main categories which may be scored by the use of the MCT are: anxiety, depression, isolation, regression, and repression. A recent description of the test and of its scoring categories was published by Smith & Danielson in 1982. The test has not previously been used in back pain studies but has been employed extensively in clinical research with good results (Nyman & Smith, 1961; Smith & Johnson, 1963; Dworkin, 1969; Lindbom, 1968; Smith, 1968; Smith et al., 1976), and for diagnostic purposes in Swedish psychiatric wards.

The Separation Test also is a modern projective personality test, based on the same basic principles as the MCT and presented to the subject in a similar manner, with the exception that only one picture is shown. The test is not administered primarily to map the individuals defense strategies (as is the MCT) but to analyze deep-seated reactions to an important human situation, i. e. separation (Magnusson et al., 1977; Westerlundh & Smith, 1982). The stimulus in this test is a picture of a mother walking away from a baby. The categories scored in the test are: activity responses on behalf of the child, anxiety, omnipotence, and splitting.

The test has not been used in back pain studies before, but was used in a psychosomatic study of ulcerous colitis (Häglund & Löfstedt, 1983).

The Rod and Frame Test is based on the psychological concept of field dependence/ independence, i. e. measures of dependency on the environment. Field dependent subjects have been found to use social referents in ambiguous situations (Witkin et al., 1962) to a larger extent and to tolerate less pain than do the more field-independent subjects (Sweeney & Fine, 1965; Dworkin, 1969). The concept represents a continuous dimension ranging from analytical perception, in which individual segments of the environment are preceived as distinct from their background, to global perception, in which the influence of the background is difficult to overcome by the subject (Sweeney & Fine, 1965; Witkin et al., 1962, 1975).

A clarifying remark should be made on the use of comparison groups from other studies in this paper. Several comparison groups are used because of the diversity of the instruments used in this study. We take the description of the procedure at face value, and use these groups as examples of other kinds of results, mainly for the purpose of discussion. These groups were only used in the statistics, after all possible comparisons had been made between the back pain groups themselves.

4. Results

Mean ages of the subjects are shown in Table 1. No significant differences between groups were found.

Table 1: *Mean ages of back pain subjects according to pain level.* No significant differences were found between categories or groups in chi square analysis.

	all subjects	pain level 1	pain level 2	pain level 3+4
Mean	47.0	45.2	46.6	49.9
S. D.	11.8	13.2	12.0	9.4
N	87	26	40	21

The subjects' gender is shown in Table 2, which also shows the number of subjects belonging to the specific pain levels. The number of subjects at pain level 1 was 26; at level 2, 40; and at level 3, 21. The mean age for subjects at level 1 was 45.2; at level 2, 46.6; and at level 3, 49.9. No significant differences between groups were found in any chi square analysis.

Table 2: *Sex distribution of subjects according to pain level.* No significant differences were found between categories or groups in chi square analysis.

	Total number	pain level 1 (n=26)	pain level 2 (n=40)	pain level 3+4 (n=21)
Females	51	15	26	10
Males	36	11	14	11

The duration of pain is shown in Table 3. On average, 86 % of the back pain subjects at each level had suffered from pain longer than 8 months. There were no between-group differences.

Table 3: *Pain Duration*. Shown are the number of chronic pain subjects, within each level.

	all subjects (N=87)	pain level 1	pain level 2	pain level 3+4
Pain duration				
< 8 months	13	2	6	5
> 8 months	74	24	34	16

Mean neuroticism and extraversion scores from the Eysenck Personality Inventory are shown in Table 4. No differences were found between the subjects at the extremes, i. e. levels 1 and 3; there were, however, significantly lower scores of extraversion in level 3 in comparison with level 2 (t-score, 2.62, $P < 0.02$). However, when these results are compared to the results from a study of a non-clinical group (Bederoff-Pedersen et al., 1964), no differences are noted.

Table 4: *Mean Neuroticism (N) and Extraversion (E) scores from the Eysenck Personality Inventory*. The back pain subjects in their allotted pain levels are compared to a group of non-pain individuals (from Bederoff-Petersen, et al., 1964) in order to show the difference between the back pain and non-pain scores. In all the chi square analyses of all these different groups, only one significant difference was found, and that was between 2 back pain groups (levels) i.e. that of the Extraversion between levels 2 and 3 (t-score 2.62).
* p <0.02.

	all subjects (N=87)	pain level 1	pain level 2	pain level 3 + 4	non-clin. group
N Mean	10,56	8.29	8.85	11.33	7.62
S.D.	12,3	4.9	4.4	5.1	4.3
E Mean	13.94	11.23	12.45*	9.82*	12.27
S.D.	3.4	3.5	3.9	3.1	3.7

The mean and standard deviations of the Lie scores of the Eysenck Personality Inventory were calculated. The results, together with values from the non-clinical subjects (Bederoff-Peterson et al., 1964), are given in Table 5. The mean Lie scale score of the non-clinical population was not found to be different from that of our back pain subject scores, when comparisons were made between each level of pain in turn, or otherwise. In view of the uncertainty of the effect of the "lie" factor upon the Neuroticism and Extraversion scores, the distribution of subjects with high and low Lie scale scores was examined (Table 6). The distributions of high Lie scores are not significantly different among the clinical groups (t-test).

The presence of average or critical Lie scores on the Eysenck Personality Inventory is associated with but small elevations (Table 7) in Extraversion and Neuroticism scores, not statistically significant, but the trends will be discussed. However, Extraversion tended to correlate negatively with Lie scores in all of the pain levels (corr. coeff., − .37, − .36, − .26, respectively).

Table 5: *Pain level and mean Lie scale scores from the Eysenck Personality Inventory.* The back pain subjects are shown grouped according to pain level, and in comparison to a group of non-pain subjects (from Bederoff-Petersen, et al., 1964). No significant differences were found between categories or groups in chi square analysis.

	all subjects	pain level 1	pain level 2	pain level 3 + 4	non-clin. subjects
Mean	4.43	4.50	4.50	3.94	3.54
S.D.	1.9	1.9	1.8	2.0	1.8

Table 6: *The distribution of critical Lie scale scores according to pain level.* Shown are the scores *of all back pain subjects* on the Lie scale of the inventory. No significant differences were found on the chi square test between any groups. Cancer pain subjects are shown alongside a group of back pain subjects as an example of subjects with a different kind of pain (from Bond, 1971).

pain	all subjects	pain level 1	pain level 2	pain level 3+4	cancer
Subjects with Lie scores below four	43	13	18	12	27
Subjects with Lie scores above four	44	13	22	9	25

Table 7: *Shown are the Eysenck Personality Inventory scores of Neuroticism, Extraversion and critical Lie scale scores of back pain subjects.* The subjects' placement depends on their score in the categories given. The subjects were subsequently categorized depending on their Lie scores being above or below four. No significant differences were found in chi square analysis, but correlations were found and will be discussed.

	pain level 1		pain level 2		pain level 3+4	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
N with						
L<4	9.46	6.0	9.73	4.1	11.4	5.9
L>4	6.64	4.3	8.14	4.6	10.6	4.5
E with						
L<4	12.61	2.9	13.57	4.3	10.0	3.0
L>4	9.78	3.6	11.5	3.1	10.8	3.5

Pain levels along with the subjects' scores on the Meta-Contrast Technique are shown in Table 8. No statistical differences were found in the frequency of Meta-Contrast Technique scores between the pain levels. In comparison to a group of non-clinical subjects from another study (Holm et al., 1972), a significantly higher frequency of depression was found among the back pain subjects as a whole, as may be seen in the table, chi square (1 d. f.), 10.42, $p < 0.01$.

The mean scores from the Separation test are shown in Table 9. No statistical differences were found between any of the scoring categories in the Separation test.

Table 8: *The distribution of Meta-Contrast Technique scores according to pain level.* Shown are the number of subjects at the 3 pain levels who have scored in the specific Meta-Contrast Technique category. The back pain subjects results were compared by chi square to a group of non-clinical subjects that had completed the Meta-Contrast Technique (from Holm, et al., 1976). A significantly higher frequency of depression was noted by the back pain subjects as a whole when compared to the non-clinical subjects (chi square, 1 df, 10.42) *$p < 0.01$.

Category scored:	pain level (n=26)	pain level 2 (n=40)	pain level 3+4 (n=21)	non-clin. subjects (N=22)
	n %	n %	n %	n %
Anxiety	14 (54)	22 (55)	10 (48)	12 (55)
Depression	14 (54)*	15 (38)*	9 (43)*	2 (9)*
Isolation	10 (38)	12 (30)	6 (29)	10 (45)
Projection	7 (27)	16 (40)	4 (19)	4 (18)
Regression	6 (23)	8 (20)	4 (19)	0 –
Repression	16 (62)	23 (58)	11 (52)	8 (36)

The mean scores from the Rod and Frame test are shown in Table 10. There were no mean differences between the pain levels, but in a comparison to a group of university students (Ryden & Danielson, 1983) the level of field-dependence was found to be significantly higher ($t = 2.6$, $p < 0.05$) for subjects at level 3.

Table 9. *Separation Test Scores, showing the distribution according to the level of pain.* No significant differences were found between categories or groups in chi square analysis.

Score Category	pain level 1 (n=23)	pain level 2 (n=39)	pain level 3+4 (n=15)
	n %	n %	n %
Activity	4 (17)	7 (18)	3 (20)
Anxiety	8 (35)	9 (23)	7 (47)
Omnipotence	6 (26)	10 (26)	4 (27)
Splitting	5 (22)	9 (23)	5 (33)

Table 10: *Mean Rod-and-Frame Test Scores.* Shown are the scores of the back pain subjects, and those of non-clinical subjects (from Rydén, & Danielson, 1983). The only t-test differences found, were between level 3 of the back pain groups and the non-clinical group. The field-dependency level was found to be significantly higher by the subjects in level 3 (t-test, 2.6, $p < 0.05$).

	all subjects	pain level 1	pain level 2	pain level 3+4	students, non-clinical
Mean	11.11	9.85	10.02	14.10	5.86
S. D.	5.6	4.8	5.3	6.1	3.8

5. Discussion

A difference might have been expected between the sexes (see Table 2). But no significant difference was found. Had the male/female ratio been even in the beginning, there might have been a chance of stating a difference. As the case had been, a large proportion of the workers in the factory were female, so that a greater proportion in that group resulted. The extraversion scores were found to be rather even in the pain levels; a difference was however found between the Extraversion scores (in the Eysenck Personality Inventory) of the subjects in pain levels 2 and 3 (Table 4). The reason for this drop in extraversion scores in level 3 cannot be deducted from our data.

However, the proportion of subjects with a Lie scale score of above four is noteworthy. As can be seen in Table 4, subjects with a Lie score of above four are: at level 1, 50 %; at level 2, 45 %; and at level 3, 42 %. Similar high frequencies have in a previous study been shown to be common among subjects with cancer pain (Blumer & Heilbron, 1981), where the frequency of patients with Lie scores above four was found to be 48 % of the patients on average. It thus seems to be common that pain patients have a heightened score (above the score recommended by the authors of the EPI as the limit of validity for the test), but the significance of the score is not clear since few attempts have been made to interpret the significance of high Lie scores in the EPI. Available studies show that high Lie scores are associated with normal Neuroticism and Extraversion scores (Bond, 1971; Knowles & Kreitmann, 1965), and that high Lie scores tend to "appear to represent the presence of a social desirability set" (Bond, 1971).

Back pain literature contains merely a few references to high Lie scores (Woodforde & Merskey, 1972; Jamison et al., 1976; Gibson, 1962; McCreary & Jamison, 1975); however, most of these studies do not report the number of subjects who had high Lie scores. According to Knowles and Kreitman (1965), the high Lie scale scorers should not be excluded, because "liars" were not excluded from the normal material by the authors of the test either. They further suggest that the elevation of the Lie scores are only to a small part due to lying. In their review of studies on high lie scores, Woodforde and Merskey (1972) refer to Morgenstern and to Bond, both of whom found high Lie scores in patients with chronic physical illness; both Morgenstern and Bond believed that high Lie scores might be a result of chronic distress, and that "faking good" might be a result of self-deception, i. e. that such subjects try to convince themselves that they are in better shape than they actually are. Eysenck & Eysenck (1964) make a similar interpretation of a high Lie score. The EPI Lie scale has its origin in the lie scales of the Minnesota Multiphasic Personality Inventory (Eysenck & Eysenck, 1964), later adapted for inclusion in the Maudsley Medical Questionnaire, the Maudsley Personality Index (MPI), and finally in the Eysenck Personality Inventory. According to the MMPI handbook by Dahlström & Walsh (1960), "The pervasive denial exemplified in a high Lie score may often be part of a naive hysterical view of oneself and of the world. Such a person may be pious, emotionally repressed, with a poor understanding of either the motives behind his own actions or the consequences of them". A similar view is expressed by Gibson in an analysis of the Lie factor in the MPI (Gibson, 1962), but he adds that such a person is likely to have awarded himself a low Neuroticism score, ". . . he may understate his neuroticism, since lack of stability is both socially penalized and personally unpleasant but as extraversion carries no particular stigma he will be quite objective on this scale". Gentry et al. describe it as a denial of emotional problems (1974).

Our own findings of Lie scores being negatively correlated with extraversion scores show that the higher the Lie score, the lower the degree of extraversion; thus, the more extrovert subject tends to score less often on the Lie scale than does the more introvert one. The significance of this trend is not yet clear. However, we found no correlation between the degree of neurotism and high Lie scores.

The separation test results show that the frequency of defense strategies in the form of anxiety, omnipotence, splitting, and motor activity are not very high, but they are constant over the levels of pain intensity as they are also in the MCT. The low overall frequency of scores in our study is compatible with the results of another study using the same test (Häglund & Lofstedt, 1983), where no relationships were found between development of ulcerous colitis and the test results.

The levels of field-dependence which have been noted in the 3 groups of this study are compatible with the level of field-dependence found in another back pain study, where the RFT was used (Lindal & Uden). Results from that study show that this level of field-dependence correlated with that of having drawn an abnormal pain drawing.

In the present study, almost all the psychological variables are relatively similar between the levels of pain intensity, a result that contradicts previous studies. Timmerman and Sternbach (1976) found that pain intensity on self-rated scales correlated positively with the frequency of depression in a group of pain patients, whereas no such association was found in our data. In this study, as in ours, most of the subjects had chronic pain.

We found a significantly higher frequency of depression among the back pain subjects in comparison to healthy subjects (Holm et al., 1972) (Table 8). The defence strategies do not seem to differ between the two original groups according to the MCT results, suggesting that, although the psychological profile might have been more diverse in the acute stages of pain, the profile had become more even in this chronic stage. Chronicity might even in itself lead to a state where the chronicity dominates over the whole person, while the intensities of pain become less significant.

In conclusion, we have found that pain intensity can not been shown to correlate with increased frequencies of depression or other psychologically altered states by the application of the psychological tests used in this study. A high Lie score on the EPI is, rather, a general rule and not an exception in back pain subjects, and these scores tend to correlate negatively with scores of extraversion, the meaning of this correlation being unclear.

As the largest part of the subjects in this study had chronic pain, we are unable to undertake meaningful comparison between subjects with acute and chronic pain. Such a comparison would allow us to see whether there is a correlation between the subjects at each pain level and the frequency of the psychological factors mentioned above, and whether these factors were connected to the duration of pain. However, in a recent study of 75 low back pain patients conducted in 1986, Zarkowska, and Philips found no differences between acute and chronic pain sufferers on measures of pain behaviour.

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Experience with minimal therapy of low back pain

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– Amended version –

1. Introduction

Low back pain, and its more defined form of sciatic radicular syndrome or sciatica, is a very old but at the same time very modern problem of medical science. We have no evidence on the frequency of these troubles in the past, but we can assume that it was the same as it is at present. Only our ancestors probably had greater tolerance towards pain or were less pampered than we are. There were many serious illnesses and especially infections which threatened the population. Medical care was expensive, and people could not stay away from work as easily. Nowadays,this syndrome has developed into a great medico-social problem. The so-called vertebrogenic pain syndrome, which involves all the aches caused by damages to the spine including those to the cervical spine, present the third most frequent cause of work incapacity and the first most frequent reason for patients seeking help from neurologists, orthopedic surgeons and specialists for rehabilitation in Czechoslovakia today.

It is unnecessary to stress that the amount of financial expenditures and the loss of working capacity are enormous.

A great deal of attention is being paid everywhere to this problem of the so-called vertebrogenic pain syndrome. We must ask ourselves what may have happened to mankind in the last thirty or forty years that the human spine is in such deplorable condition. According to our experiences the causes are the following:

(1) A great number of people work in sitting position, engage in no effort-demanding activities, thus weakening the muscles of the body.

(2) Abrupt physical overexertion in sports activities or in different hobbies, such as hard work once a week in the weekend house.

(3) Gymnastics and sports demanding extensive agility and flexibility of the joints, especially by people of middle age or older when the connective tissue is no longer so elastic as in youth.

(4) Easy access to medical care and excessive faith in treatment possibilities.

(5) The large range of analgetics and myorelaxants available and their abuse.

2. Research Method

We concentrated our attention on cause (5): the large range of analgetics and myorelaxants available, and their abuse. We found that patients using strong analgetic drugs spend more time in treatment to overcome the painful vertebrogenic syndrome than other patients who use less intensively acting analgetics or generally take fewer drugs. We are aware that to compare groups of patients for which pain is the only predominant symptomatology, is very problematic. Nevertheless, we have worked out a reasonable therapy based predominantly on psychotherapy and instructions how the patient should manage his movements. First, we explain to the patient the positive aspects of pain as a protective factor warning the subject before a damage occurs. We recommend acceptance of the vertebrogenic pain syndrome as a normal process of growing old.

It is important to not only ask the patient what causes the pain, but above all to ask him what he can do without pain, and to suggest to him to engage in movements he can execute without pain or under bearable condition. Crawling is a painless form of locomotion in practically every patient. If the patient is able to walk in upright position, we do not reject a scoliotic posture or use of a cane.

The time spent for treatment of low-back pain has been measured from the first day when the patient enters the consulting room to the last when the therapeutic program dealing with the attack is finished. So we can calculate the approximate average time in previous attacks and compare them with the time necessary for treatment using movements which do not cause pain and therefore avoid a need for analgetics and myorelaxants. We still prescribe analgetic drugs for the patient, asking him at the same time not to use them or only if the pain becomes unbearable. We always prescribe psychorelaxant drugs and some hypnotics for the night.

3. Results

We followed-up on a group of 20 cooperating patients who have had six or seven previous attacks of low back pain and also show a radicular symptomatology. The average duration of these attacks, treated with strong analgetics, lasted 25 days. The average duration of attacks with reduced drug therapy and with the use of painless movements lasted only 21 days.

4. Discussion

Not every patient accepts this therapeutic regimen, but people who have numerous recurrences and know that total cure does not exist come to an understanding. Eight of the above mentioned patient group were physicians, who are relatively trustworthy respondents with minimal suggestibility. In four cases an operation of the intervertebral disk had been proposed but was not carried out. When the painful attack is over we recommend to the patients to let the offending part of the back stiffen a little since the connective tissue and cartilage surfaces of joints are not as elastic as in childhood. We recommend slow exercises strengthening the paravertebral and abdominal muscles, and warn of attempting to increase the extent of movements.

5. Summary

A group of 20 patients suffering from repeated low back pain with radicular symptomatology in area L5 or S1 was followed-up during an acute attack, without use of some kind of analgetics or only in very reduced quantity. The protective function of pain and especially low back pain had been explained to the patients. The patients were instructed to engage in all movements which do not provoke pain, or if so, at an easily bearable level. They may have to walk with a scoliotic posture or to crawl. The average time of vertebrogenic pain attacks treated with analgetics lasted longer than the ones with minimal drug therapy.

The dynamics of vertebrogenic pain and autodermographic recording

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– Amended version –

1. Introduction

The only predominant symptomatology in the low back pain syndrome is pain, i. e. a subjective experience without possibility of objective verification. Nearly all patients who were seen for vertebrogenic pain syndrome had previously experienced intermittant low back pain, topically diffuse and varying in severity from rather mild to occasional severe pain attacks, which persisted and eventually developed into clearly definable lumbar radicular symptoms. For the physician, diagnosis and treatment of this pain syndrome is a very difficult and time-consuming task.

2. Research method

Pain in the vertebrogenic pain syndrome of different etiologies is recorded by means of autodermographic blanks, in which patients enter their subjective sensations. Classic autodermography is well known but cannot be carried out in the back region, so we are left without any permanent documentation. These schematogrammes on the contrary can be filled in repeatedly by the patients in the course of their disease, so that the development of sensitive complaints can be demonstrated by the sequence of such recordings. This method moreover has positive implications from the psychotherapeutic point of view, especially in intelligent patients, who are favourably affected by their active participation and involvement in treatment. The patients get a number of blanks for recording of their personal "autopaingramme."

Over the last nine years of experience with this method, we have collected a great number of these recordings, many of them without any great value but some of them revealing typical pain dynamics, which fall into certain characteristic patterns allowing us to discern the course of the condition.

3. Results

Six different types of pain are distinguished:

1. Radicular pain discharging and descending downwards along the appropriate dermatomere (Figure 1 a–f)

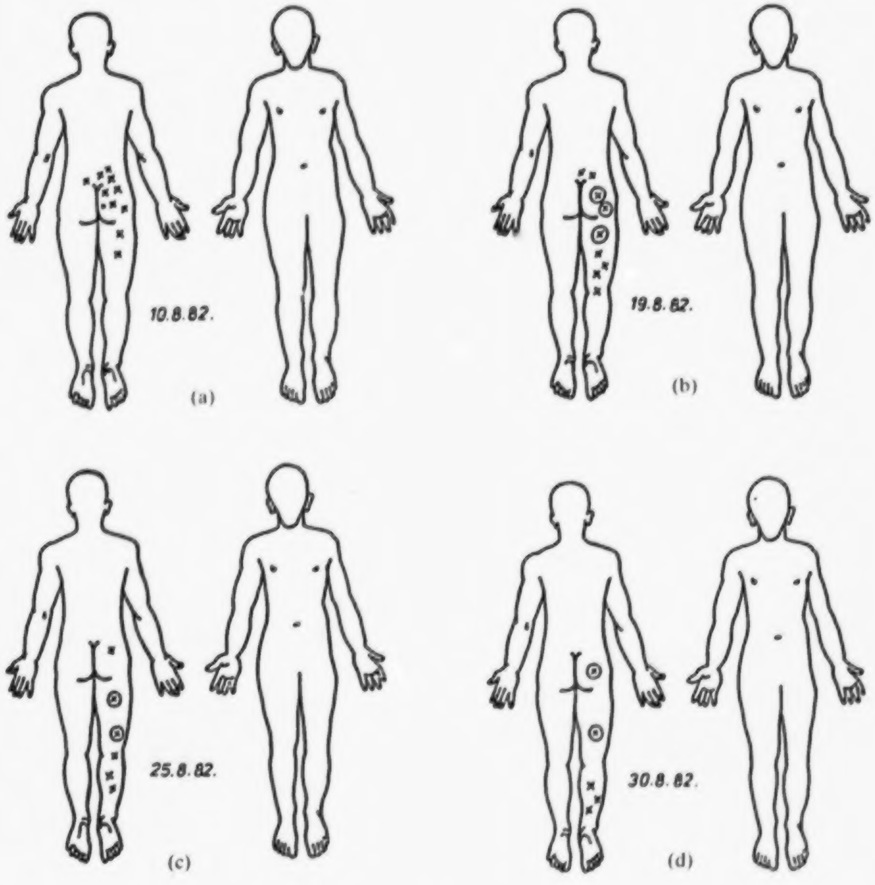

Fig. 1

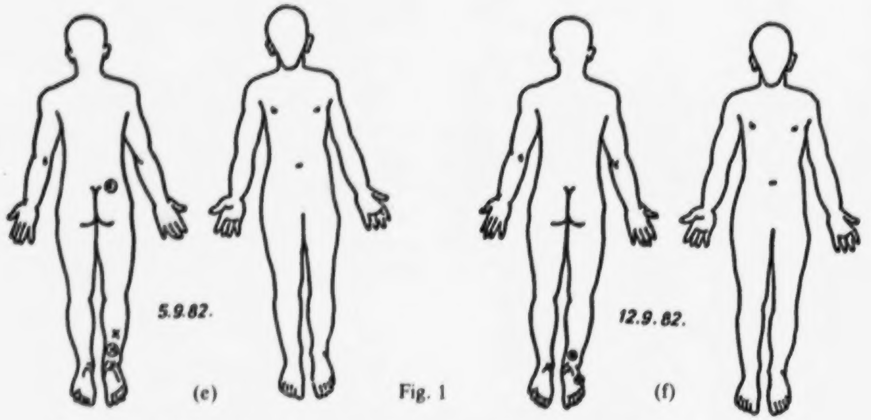

Fig. 1

Figure 1 a–f: *Pat. A. N. – the radicular pain descending downwards in S 1 dermatomere.*
x = intensive pain, ⊗ = intermittant moderate pain.

2. Radicular pain which also changes its position and tends to retreat upwards in the appropriate dermatomere and disappear in the low back region
3. Pain discharging in the large area of low back and gluteal region and disappearing diffusely
4. Pain in different extremities
5. Low back pain without discharging character
6. Other, mostly atypic pains.

4. Discussion

Pain types 1, 2 and 3 are supposed to be provoked by prolaps or protrusion of the intervertebral disk, more precisely, of the nucleus pulposus, which compresses the nerve root. The pain which retreats upwards is believed to be a slowly disappearing radicular pain, even though we must admit that the pain is very far above its origin, i. e. the compressing prolaps of the disk, and that the pain is moving in antidromic direction.

The most frequent and most interesting however is the type 1 pain, in which the initial pain is localized in the low back region and discharged towards the leg along the 5th lumbar or 1st sacral nerve root. Pain dynamics show a tendency for the pain to descend to the heel or the instep, disappearing through the toes. This type of pain resembles the phantom pain suffered by amputees (Fig. 2). The patient also feels the pain at a distance from its origin in the lumbar region, pain duration is prolonged, and the pain descends downwards in an antidromic manner against the leading course of the neurons.

We do not know whether, and to what extent, a sensorial memory exists in our brain. We know of the existence of an optic and acoustic memory, but pain sensation can normally not be evoked from memory. But there is an irrepressible rememberance for instance of a melody, which is an experience made by nearly all normal subjects. In our patients, we very often noticed that the importance and intensity of the pain diminished with occupation, and was increased at rest. The same has been observed in the phantom pain of amputees. It is at any rate believed, though we have as yet no proof of it, that the long-lasting radicular pain has its origin much more in the brain than in the leg (Fig. 3), possibly in terms of a long-term memory "engraving" in our brain.

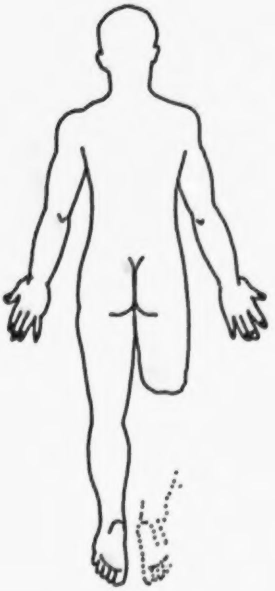

Figure 2: *Phantom pain.*

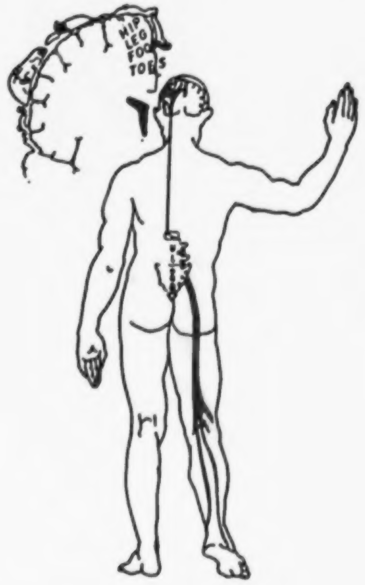

Figure 3: *Pain pathways.*

The type 4 in the pain picture, where the pain occurs in different extremities, must be attributed to some other diagnoses, as opposed to the simple radicular syndrome. Type 5 represents the classic low back pain, which is very common and most frequent in the pain recordings. There are many conceivable subdiagnoses, such as iliosacral joint blocade, ligamental pain, etc., but we very often cannot give a definite diagnosis because neither neurosurgery nor pathoanatomic verification is possible. The type 6 pain is variable and very often involves different superimposed functional causes, or even simulation.

Construction of an observation scale for the behaviour of pain patients

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1. Introduction

The expansion of different behavioural treatment modalities for chronic pain over the last decade has inspired many researchers to evaluate the relative contribution of these different pain programmes. When performing such therapy-outcome research, reliable and valid pain assessment techniques are indispensable if not crucial.

Reviewing existing measurement techniques for clinical pain, we concluded that there is a need for observational measures focusing on "Pain Behaviour". The clear advantage of these observational measures is their relative objectivity, and the variables measured are often clinically relevant. A disadvantage is that it can be difficult to separate behavioural measures from the context in which they are collected. Nevertheless, as Fordyce (1983) stated: "A basis has been provided for relying more on what pain patients do as a pain measure than on what they say". Indeed, pain behaviour as a construct has been introduced by Fordyce (1976). He defined pain behaviour as the interaction between the person who suffers pain and his surrounding world. It concerns all patterns of behaviour generated by the individual, commonly understood to reflect the presence of nociception. It includes speech, facial expression, posture, seeking health care attention, taking medication, and refusing to work.

2. Behavioural measurements: problems

Several researchers (Keefe & Block, 1982; Richards et al., 1982) have attempted to develop objective measurement strategies by focusing on pain behaviour. Although each of these approaches is an advantage over reliance on self-report data, the behavioural measurement of pain faces at least four major problems:

(a) There seems to be no consensus about the range of behaviour that should be assessed (Turk et al., 1985). Some investigators take into account only 4 pain behaviours (Cinciripini & Floreen, 1982), while others include 10 different behaviours (Richards et al, 1982).

(b) Neither is there a consensus about the method of assessing pain behaviour (Turk et al., 1985). There appears to be a dilemma concerning the precision of measurements. Some investigators use video-tape recordings of pain patients in standardised and hence artificial situations (Keefe & Block, 1982). Others use procedures which can be used in more naturalistic settings (Richards et al., 1982). Although the latter risk to sacrifice precision, they seem practically more useful.

(c) Almost all observation scales are basically ordinal and allow a limited use of statistics. This can hamper research activities.

(d) The reliability and validity of these procedures as operational measures of pain have been insufficiently studied by carefully designed investigations (Chapman et al., 1985).

The present study was designed to construct an observation scale for pain behaviour, which should be easily applicable, preferably by nurses, in quasi naturalistic, clinical settings. It is based on a pain behaviour construct in the broadest sense: the interaction between the pain patient and his environment. Given practical considerations, we chose the daily interaction between patients and nurses in a Medical Rehabilitation Unit.

3. Classification of pain patients behaviours

In order to inventory the daily interactions between pain patients and nurses, nursing progress notes in 96 medical charts of back pain patients hospitalised at the department of Rheumatology of the Lucas Foundation for Rehabilitation (Hoensbroek, NL) were analysed. 232 behaviour descriptors were collected. Low-frequency behaviours were omitted, and similar descriptors were put under the same denominator. This resulted in a final list of 95 different behaviours such as "says that he is tired", "takes pain medication", "is quiet and withdrawn", etc.

These items were classified by the authors into 10 categories labeled as: (1) verbal pain behaviour, (2) non-verbal pain behaviour, (3) fatigue, (4) passivity, (5) stiffness, (6) seeking attention, (7) sleeplessness, (8) anxiety, and (9) depression. A tenth category consisted of a group of miscellaneous items not belonging to one of the 9 preceding categories: It is clear that different categories can be used. Therefore the authors chose to be guided by categories relevant for clinical pain and already described in the literature, such as sleep problems (Savitz, 1985), anxiety and depression (Sternbach, 1970) and distinction verbal/non-verbal pain behaviour (Richards et al., 1982). To make sure that sufficient interprofessional consensus in regard to this classification was reached, an experiment involving 8 colleagues was set up. The results support sufficient consensus.

4. Towards an interval-scaled instrument

For each behaviour category, an attempt was made to construct a five-point rating scale, in order to assess the degree in which that kind of behaviour is present. Two problems characterise such a rating scale. The first problem has to do with so-called "low-raters" and "high-raters". Some raters seem to score consistently low, while others score consistently high, a problem which might affect the reliability of the scale. The second problem concerns the properties of the scale itself. Rating scales, like most psychological scales, are basically ordinal, allowing only limited use of statistics.

In this study, an attempt was made to overcome both scale-related problems. A way to avoid the first problem is to provide each of the 5-point rating scale with "anchors", i. e. written statements which reflect the different degrees in which a certain behaviour can occur. The second problem is more difficult to tackle. The distance between the "anchors" is a psychological one and will differ individually. The only way to go is to obtain group consensus about the formulation of the anchors so that equality of intervals is approximated. A second experiment was designed for this purpose. The conclusion is that for 3 behavioural categories, an interval scale was reached, and for the other categories an interval scale was fairly well approximated.

5. Reliability

Inter-rater reliability was assessed in two conditions. In an artificial condition, independent raters observed video-taped sessions of actors roleplaying pain patients. In the second condition, the same raters scored real pain patients during their therapy sessions. In this condition, test-retest reliability was assessed as well. Observers rated the patients on two consecutive days. For both conditions, an experiment was set up. When 3 observers from different disciplines rate role-played pain patients in a standardised condition, the inter-rater reliability appeared significant (.71, $p<.05$). In contrast with the results of the video condition, the inter-rater reliability is not significant in the real-patient condition (.12). The reason for this discrepancy may be that patients behave differently in the different settings in which they were observed. The real-patient condition was in fact not standardised, which may have produced different ratings from the observers. Test-retest reliability is significant (.62, $p<.05$), and fits with the expectation that pain behaviour on two consecutive days is not significantly different.

6. Validity

A form of criterion validation was carried out by means of the video condition experiment. For each of the 18 video recordings, an ideal rating was produced by the authors together with the actors. These ratings were then correlated with observers ratings. The mean correlation coefficient was .89, i. e. significant ($p<.05$). In other words, the observers met our criterion, they rated the role-played pain patients the same way as the authors did.

7. Discussion

The pain patient observation scale is a relatively simple and quick method for quantifying pain behaviour, defined as the interaction between the pain patient and his environment. The behaviour categories have their origin in daily nursing progress notes and meet with sufficient interprofessional consensus. An interval-scale was approximated with considerable success.

Preliminary data suggest sufficient reliability. The inter-rater reliability in a non-standardised, natural setting needs further attention. Although criterion validity in the video condition appeared to be good, further validation is necessary.

Finally, it will be important to examine the discriminative value of the scale. Do chronic pain patients show different results compared to acute pain patients? In which aspects do chronic pain patients differ from chronically anxious or depressed patients? Answers to these questions will contribute not only to the refinement of the scale, but also to the research on the nature of chronic pain itself.

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Chronic pain: Measurement and assessment

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The topic "Chronic Pain Measurement and Assessment", while an interesting topic to consider and discuss, is at the same time a perplexing subject. Much has been studied and written about the subject in the last 45 years, yet there still remains much controversy about the best techniques to utilize, and what we are actually measuring.

No one in this group needs to be convinced of the desirability of measuring and quantifying pain. Reading notes, it is vital in the diagnosis and evaluation of the treatment techniques with procedures to quantify pain critical to therapeutic and scientific progress in these areas. Without adequate methods for measurement, pain treatment will continue to be adopted and utilized without proper scientific evaluation. Additionally, as Pain Clinics become more numerous, and the evaluation and treatment of chronic pain more costly, the concept of cost effectiveness becomes more important. Scientifically established and proven assessment techniques will be vital in evaluating alternatives, less invasive, less extensive, and therefore less costly techniques for treating chronic pain.

Measurement of induced acute pain is relatively easy when contrasted with the measurement of chronic pain. In laboratory-induced acute pain, there is a lack of emotional or cognitive connotations, and the quantity of the pain stimulus is easily controlled. The tail flinch test, in which one measures the latency of the application of heat to the rat withdrawing and/or flinching his tail, is a typical example of the measurement of acute laboratory-induced pain. Obviously then, one can assess the results of treatment like insertion of electrodes into the periaquedial gray area of the brain by evaluating the rise in the tolerance of the pain by the lengthening time until the flinch is accomplished.

In the measurement and assessment of chronic pain, unfortunately, we do not have an acceptable laboratory model. It is difficult to capture what is a very private sensory experience. Many times, all we have are the words of the patient, his recollections of his experience and the behavior that he exhibits when he has this private experience. Doctor Houde has noted, "at the present time, we have no better measurement of pain than the patient's report of its presence and severity in their own words." However, Busey notes, "we have no reliable objective measurement of pain, obviously the patient's statement about the severity of this pain is worthless." While it may be true that the measurement of chronic pain requires significant study and investigation, we should not do as Busey further stated, "it would appear in view of the lack of objective measurement as to what is pain and what is its severity that this is not the time for the U. S. National Institute of Health affiliates to spend any considerable amount of money on the study of the treatment of pain."

Sternbach notes that pain is a complex experience, with evidence confirming that it involves variation on several dimensions, dependent upon ever changing states, continuously influenced by a multitude of extrinsic and intrinsic stimuli. Fordyce describes four main components of pain, nociceptive, sensation, suffering, and behavioral. Thus a clear linear relationship between amount of noxious input and intensity of pain experienced is not true in chronic pain. The problem is further compounded by the very narrow range of pain sensation. The energies that are delivered at the pain receptor surface necessary to produce a maximal intensity response, and the energy necessary to arouse threshold is 2 to 1. So over this very narrow range, we ask our patients to quantify pain on an analogue scale and/or with descriptive terms. Thus, you can see their dilemma as well as ours.

Using Sternbach's and Fordyce's concepts, three components of chronic pain measurement are noted: subjective, physiological, and behavioral. The interaction between each component is dynamic and ever changing, and involves a balanced appraisal of sensory input and the degree to which this is modulated by psychological factors including other determinants of verbal and overt behavior. Of course, any scale must meet a few basic criteria including ease of administration and scoring; be used accurately by a variety of health care professionals; interrater reliability must be high, and it must be a valid measurement of pain.

While most chronic pain measurement techniques address one or more of these components, a few, including the North Carolina Pain Clinic Profile and the Shealy Pain Profile, tend to incorporate all three into the assessment system. Thus we can see that there are several types of pain measurement instruments based on the component of pain we want to examine.

The subjective component of chronic pain measurement is reflected by rating scales, questionnaires, and diary cards. Subjective scales should attempt to distinguish between severity and quality of pain, if possible. Rating scales, while the most common, and many of them reproducible in response, are undirectional and do not reflect the complexity of the pain experience. Combining rating scales with psychophysical scales have attempted to overcome this problem, with different dimensions of the pain experience evaluated.

Questionnaires have gained wide acceptance, with the McGill Pain Questionnaire as the most well known and popular model. It evaluates three major classes of word descriptions, sensory, affective and evaluative, that are used by patients to specify the subjective pain experience, combined with a built-in intensity scale. The literature is full of reports evaluating this method of pain measurement, and it has been used extensively in clinical evaluation and treatment trials. It is felt by Melzack and others to provide quantity information that can be treated statistically and is sufficiently sensitive to detect differences among different methods to relieve pain.

Fordyce notes that there may be a questionable relationship between what people say about pain, and what they do. Accordingly, the evaluation of chronic pain should include an analysis of patient behavior. Our pain program also demonstrated significant discrepancies between McGill response and the way the patient feels about his pain. A patient may say, "I'm no better at all, this hasn't helped me at all", and yet the McGill Pain Questionnaire will show a marked drop in his McGill score.

Diary cards, which note intensity and duration of pain, have likewise been used in the subjective measurement of chronic pain. There seem to be some problems with getting them completed, and also with their being retrospective in nature. We have had limited experience with this method of pain measurement, and literature does not reflect a wealth of scientific studies on their validity or appropriateness in measuring chronic pain.

Physiological techniques to measure pain, while perhaps having a firm scientific basis, have had little evaluation in the clinical setting. Techniques such as cortical evoked potential, muscle tension, vasodilation, heart rate and blood pressure, while used in the laboratory, have not been scientifically evaluated in clinical settings. Reading believes, in general, there would seem to be little basis for discrete physiological changes relative to the pain experience. Doctor Hyyppä, in his abstract and presentation this morning, discussed psychoneuroendocrine observation as a quantative and objective evaluation of chronic pain.

Behavioral measurements of pain frequently advocated by Fordyce are logical techniques to measure pain, since people in pain must engage in behavior indicative of their state. Most behavior measurement techniques utilize three categories of behavior: somatic intervention, impaired function, and pain complaints. The University of Alabama behavioral measurement of pain is based on ten behaviors like vocalization, and the frequency and intensity of these expression. Perhaps this is the best type of pain measurement when evaluating the cost effectiveness of chronic pain management programs. While this technique in theory is ideal, there are problems with correlation between behavior and other rating techniques and methods of collection of data (indirectly versus directly). While interobserver reliability is good, you need many trained observers, and many observations, to obtain appropriate information. An inpatient program with virtually constant observation of the patient would be necessary in order to arrive at a proper assessment. Doctor Vlaeyen this morning discussed a scale to evaluate pain from a behavioral point of view, and when his results are final this may prove to be a valuable tool in this area of evaluation.

Multiple evaluation techniques are probably best in the measurement and assessment of chronic pain, and the following procedure is utilized at Baylor College of Medicine. We ask the patient to assess a number of measurements by way of the Sternbach/Picazza scale, including:

(1) Limitation of activity	0–100 (bedfast) (no limitation)
(2) Waking hours pain present	0–100
(3) Intensity of pain	0–100 (excruciating) (none)
(4) Effect of pain on mood	0–100 (totally withdrawn) (none)
(5) Drug type and dosage	Coded 0 (aspirin) – 100 (morphine q 3 hrs)

The scores are horizontally distributed with descriptors and summated to give a total score. These subjective scores when summated, however, can give false information, like any other method of summated evaluation.

I would like to spend a few moments discussing our evaluation of this scale as well as other direct and indirect measurements of pain and behavior performed in our Pain Management Program. At Baylor College of Medicine Biofeedback and Pain Control Program under Doctor Blacker, a number of factors are being evaluated besides the pain measurement scales to predict "winners and losers" in a Pain Management Program. Information is obtained by questionnaires with input directly fed into a computer to allow multiple ongoing analysis of data. Patients also perform an MMPI for guidance in managing the psychosocial contribution to pain. However, it has not been demonstrated in our hands to enhance outcome predictability. Doctor Lindal this morning discussed the incidence of psychological factors and the need to evaluate and treat them, which coincides with our observations.

We have also utilized the ischemic tourniquet test to match externally delivered pain stimuli to the patients own pain. We have attempted to use this pain measurement technique to determine which patients would be good candidates for a pain control program. The blood pressure cuff is inflated above systolic pressure by about 30 mm hg using the Esmarch bandage, and all blood is expressed from the arm. The patient grips the gripping device repeatedly forty times. The longer the ischemia, the greater the accumulation of metabolites, and the greater the pain. From this we derive a pain ratio and pain tolerance. The nominator is the time the patient experiences discomfort equal to his pain syndrome, and the denominator the time to tolerance (cuff is then released); i. e.

$$\frac{\text{pain threshold}}{\text{pain tolerance}} = \frac{120 \times 100}{200} = 60$$

This procedure has significant limitations, among them that pain intensity and time are not linear. But it seemed reasonable to conclude that those with poor tolerance would be poor candidates for the pain clinic and those with high tolerance to be good ones. While small numbers of tests indicated this to be true, this proved not to be the case as we gathered more patients. Patients with low tolerance and high tolerance both did well, while those in the middle did not perform as well.

While this test cannot necessarily be used to measure outcome in the individual patient, it does give information on how the patient does respond to pain.

Similarly, the four deep breaths test, a measurement of autonomic function, is being used as a guidance tool in the treatment of patients with chronic pain and has shown some prediction of success. The test is performed by the patient taking four deep breaths and measuring sweat activity. Patients who show a rise of 3 micromoles have a 70 % chance of success in our program. The test seems to measure autonomic liability and the degree to which we have autonomic investment in one's sensory experience. Thus, if a patient had a significant autonomic component in his pain, learning to control that component should lead him to better control of his pain.

We have attempted to define a "winner" in our program as back to work, off addicting narcotics, off third party support, and 50 % pain reduction as measured by our pain measurement scale previously discussed. Age and number of surgical procedures did not seem to have significant effect on the outcome. However, patients with lawsuits pending, and quitting work because of pain had poor outcomes. Favorable outcomes were seen in patients with low initial drug intake, but results were not linear. Likewise, patients with low intensity of pain had favorable outcome. Patients not on workmen's compensation, and those off work for less than one year seem to be potential winners, with outcomes improving as the educational level of the individual rises. These results were seen with short-term and intermediate-term follow-up.

This discussion confirms that there is no ideal method to evaluate and measure chronic pain and its treatment techniques. Measurements that reflect subjective physiological and behavioral components with independent and direct monitoring are most appropriate. Reading states that behavioral indices may assume greater importance as chronicity increases, since the question of how much the patient is able to do rather than how much it hurts may be the more important question in a chronic pain management setting. This is especially true in looking at the cost effectiveness of pain management programs.

It would seem that research in the area of measurement, assessment and outcome of patients with chronic pain is still fertile ground for continued investigation.

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Group 8:

Free papers

Chair: Dr. Paul Dollfus, Mulhouse, France

Perceptual evaluation in occupational therapy

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1. Introduction

Brain-damaged patients are a large and growing group in our hospitals. Rehabilitation is a demanding and difficult process, and there is a wide variety in symptoms and recovery. Complicating factors in many cases, apart from the physical impairments, are the neuropsychological or perceptual deficits which affect the patient's abilities to care for himself and to carry out meaningful activities.

To help overcome these difficulties is one of the most important aims of occupational therapy.

2. Method

The first step to successful therapy is precise and comprehensive understanding of the general physical and perceptual deficits in brain-damaged patients, and it is the purpose of the testscreening described below to provide the occupational therapist with an instrument for evaluating perceptual functions and deficits in the individual. This is to help develop realistic guidelines in the selection and application of methods and materials for treatment.

The main clinical aspects of screening are as follows:

- to make the perceptual and motor deficits visible to the occupational therapist;
- to make intact functioning visible;
- to devise the exact plan of treatment as well as the choice of exercises and materials;
- to obtain objective observation and assessment of the course of the condition.

After systematic analysis of materials and treatment procedures applied in occupational therapy, a comprehensive evaluation scheme was designed to investigate the following perceptual functions;

– *body awareness;* – *stereognosis;* – *apraxia;* – *visual gnosis;* – *scanning and spatial neglect;* – *spatial relations;* – *constructional skills.*

Each section consists of 5 to 9 subtests, which mostly consist of several tasks, graded from simple to difficult, from concrete to abstract.

The screening combines various psychological tests, proven clinical methods of investigation and recognized occupational therapy materials, modified and adapted for different kinds of disabilities.

3. Administration of Tests

This evaluation, above all, is especially indicated and useful for the investigation of patients in the early stages of rehabilitation, when they are frequently still unable to perform the more complicated tests generally used by psychologists.

Testing should be done as soon as the medical status has stabilized. Beforehand, the therapist should obtain information on the history of the illness and the present physical and mental condition of the patient. In order not to overtax the patient, the test should be taken in parts, and speed is of little importance. Before commencing the test, the therapist should reassure the patient, and explain what to expect.

If any disorder of language ability is present, some test parts cannot be administered, others must include extra visual cues. The examiner must always be sure that the patient understands what is expected of him.

The therapist must also be aware of any visual field defect, and be prepared to comment appropriately if the patient's difficulty in performance appears to be due to neglect, or fatigue, for instance.

4. Example of Test

I would like to describe one part of the screening in details, namely the *Constructional Skills* part with its different subtests. Like in the other parts of the test, administration begins with a definition and a remark as to what the therapist has to pay special attention to in general, because the examiner has to understand what he is looking for and recognize problems when they arise.

In the first task, the patient has to arrange 12 small discs in their proper order on a large disc so as to resemble a clock. Subsequent tasks are:

- to copy four peg-board compositions in increasing grades of difficulty;
- to copy four concrete block compositions in three dimensions;
- to draw three designs in two dimensions.

If it is not possible for the patient to draw with a pencil due to poor hand function, he can copy similar designs with sticks instead.

This is of course easier than reproduction requiring crossing lines and changing directions, but it does give an idea of whether the person is able to arrange objects in two dimensional way.

Then, the patient is asked to perform the following tasks:

- to reproduce 3 two dimensional designs from short-time memory;
- to comprehend a design drawn by the therapist, and to continue the design meaningfully, *or* to continue two difficult peg-board compositions;
- to make some patterns with the Mosaic Test, which is available in a size suitable for handling;
- to make a floor plan of his own bedroom in the hospital.

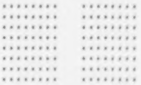
For this latter task, if the patient is not able to handle a pencil, he can choose among five finished plans to select the one representing his room, and the therapist gives him plain pieces of flat wood that he has to arrange the way the furniture is located in his room. This, too, is easier than reproduction by drawing, but the task can be regarded as a good substitute.

The way each task is solved will be scored using a 4 part scoring system that usually has the following structure:

Name of Hospital: **Patient:**

Test Date:

Perceptual Evaluation – Results of
CONSTRUCTIONAL SKILLS

TASKS	SOLUTION	COMMENTS	1-4 P. SCORING
1. Clock Face	description of mistakes:		
2. Time-Setting	5.00 9.00 25' past 5.00 10' to 8.00		
3. Peg Board Designs			
4. Block Designs in 3 Dimensions	Model 1 Model 2 Model 3 Model 4		
5. Designs in 2 Dimens. A) Drawing B) Sticks	Pattern 1 Pattern 2 Pattern 3 include drawings!		
6. Designs-Reproduction	Pattern 1 Pattern 2 Pattern 3 include drawings!		
7. Design-continuation A) Drawing B) Peg Board	A) include drawing! B) 		
8. Mosaic-Test	1 2 3 4 5 6 7 8 9 10		
9. Ground-Plan A) Drawing B) Choice of Models	A) include drawing! B) description of performance:		

Total:

Fig. 1: *Score sheet for „Constructional Skills" subtest*

Name of Hospital:

PERCEPTUAL EVALUATION - RESULTS

Patient: **Sex:** **Age:**
Diagnosis:
Further Diagnosis:
Education/Profession:
Test Date:
Therapist:

	Patient's level	normal standard	severe dysfunct.
Body Awareness (BA)		24	6
Stereognosis (SG)		20	5
Kinetic Apraxia (KA)		20	5
Ideomotor Apraxia (IMA)		36	12
Ideational Apraxia (IDA)		36	12
Visual Gnosia (VG)		28	7
Spatial Relations (SR)		24	6
Constructional Skills (CS)		36	9

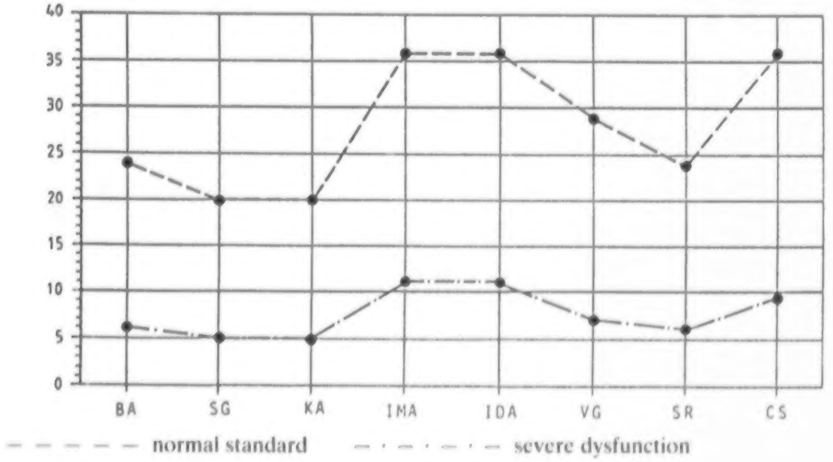


Fig. 2: *Representation of total test results*

4 = intact perception for basic functioning
3 = minimal dysfunction
2 = moderate dysfunction
1 = severe dysfunction

The ratings are recorded on a score sheet (Fig. 1), together with any observations as to *how* the patient approached the task, because the quality of responses is as important for therapy as the quantity. Total results, as in all other test fields (Fig. 2), are recorded in a general profile, which is complemented by a graphical representation of the patient's scoring.

If the patient's performance is at the normal standard level, this, however, does not indicate that no perceptual problems are present but that basic functioning is intact.

Of course, this scoring system mainly represents a subjective method of measuring; but test results have been very useful in identifying those perceptual deficits that frequently influence the patient's performance and that can be treated by occupational therapy.

After the evaluation is completed, we discuss the results with the patient, in an appropriate language. This helps him to realize what he is capable of, that, in spite of his handicaps, he is efficient within his possibilities. But it also prevents him from overestimating his present capabilities. Together, we discuss the aims and objectives of treatment exercises, and point out what, for both of us, is important and possible to attain for normal life situations.

This clarifies the purpose of occupational therapy, and makes it more meaningful to the patient. It gives the patient the feeling of certainty and that everything is being done for his well-being, and will also increase his motivation and own effort to improve.

5. Results

The testscreening has been developed in close co-operation with a psychologist, and this cooperation continues throughout the administration of individual tests as well as in the subsequent treatment programs. But let it be emphasized that, in our opinion, the occupational therapist should arrive at his own evaluation directly, and not get it second hand. Only in this way can he fully assess and comprehend the problems confronting the patient.

The main advantages of the screening may be summed up as follows:

(1) The test helps the occupational therapist

- to ascertain, as soon as possible, the perceptual status of the person tested, and to set up a more effective treatment program in a systematic manner according to the findings;
- to avoid both overtaxing and undertaxing of the patient, through better individual adaptation of the concrete procedures and materials used in treatment and their adjustment to the needs of real life situations;
- to recognize that the pattern of scores suggests the relationship between the various tasks, indicating the training which will be required for learning to do other tasks;
- to find out *how* the permanent damages can be compensated for by other, unimpaired abilities.

In this way, treatment will become an approach integrating the different fields of performance, instead of dealing with separate functions.

(2) The application of the assessment tends, also,

- to sharpen observation of patient's abilities and to isolate more easily the reason for failure in a particular activity, when therapy is in process.

(3) Finally the test is useful

- in demonstrating improvement over a period of treatment, in that some details of the test may be repeated at varying stages of treatment;

- in stating results in concrete terms, thus providing meaningful data and readily perceived by other members of the team;
- in making the therapist once again aware of his special responsibility within the rehabilitation team for the brain-damaged patient.

6. Conclusion

The screening presented here is an informative, non-standardized test profile having a sufficient degree of content validity for most of its subtests.

We are working on an empirical study that seeks to establish the correlation co-efficient between the diagnostic information given by the screening on the one hand, and the results of comparable (similar) standardized psychological tests and clinical methods of investigation on the other.

In conclusion, it should be mentioned that the screening described here has to be critically scrutinized and possibly be changed or extended in co-operation with other institutions.

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A comparison of simulated and realistic emergency stop responses: Relevance of driving assessment

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1. Introduction

There is dearth of knowledge about the factors which allow doctors to declare whether or not certain groups of disabled people are fit to drive. In many cases the decision is straightforward, e. g., there would be no medical contraindication to an otherwise fit, young man who had lost the use of a limb in a road traffic accident driving a suitably adapted vehicle. On the other hand, a severely brain damaged, partially sighted and ataxic victim of a road traffic accident will almost certainly not be able to drive. Between these black and white examples exist a group of patients whose assessment is more problematical, in particular subjects with a moderate degree of brain damage. Sivak et al. (1981) showed that even minor cognitive and perceptual deficits adversely affect driving performance, while Wilson and Smith (1984) showed the driving performance of a group of stroke patients to be inferior to normals. Wilson and Smith (1984) suggest that the timed response of brain-damaged subjects to an emergency stop may be an indicator of their overall driving performance as well as being a relevant performance characteristic.

It, therefore, seems desirable for brain-damaged subjects (whatever the cause) to undergo an assessment more realistic than a simple clinical examination. Driving assessment has developed in many countries along lines similar to the four stages used at our Centre, namely: (1) clinical examination, (2) psychometric tests (where appropriate); (3) test rig examination; (4) in-car tests.

This study focusses on the test rig examination and in-car tests.

2. Aim

The purpose of the study is to compare emergency stop response time determined on a test rig with those determined "in-car" using a realistic stimulus for normal controls and patient groups.

3. Methods

(A) Test Rig: The test rig is a mock-up of a car, which is used to measure the strength and range of movement of a subject while operating the various controls (conventional or various specialised adaptations). The best type and layout of controls can thus be determined. The test rig also functions as a reaction timer. The subject sits on the test rig with the accelerator depressed and a light activated. The time taken to move his foot from accelerator to brake or to operate a hand controlled accelerator/brake lever is measured. The test is carried out initially with the light position fixed dircetly ahead, and subsequently the position of the light is varied between 25 ° and 85 ° giving two reaction times.

(B) In-car Response: For the realistic emergency stop, the stimulus used for each subject had to be standardised. We decided on a life-sized wooden dog on wheels, launched in front of the car by a servo-mechanism the instant the vehicle breaks a light beam placed 15 metres away. This gives a realistic and reproducible emergency stop. Each subject had a familiarisation period in the vehicle before undertaking the emergency stop test.

The response of the subject to the emergency stop was recorded on cassette tape by a purpose-built computer linked to sensors on the vehicle. The information stored on cassette could then be obtained as a printout.

4. Subjects studied

There were 59 normal controls aged 16 to 71 years, average 36 years, S. D. 16. The 51 patients (aged 15 to 78 years, average 36, S. D. 19) had all been referred to the Vehicles Centre for assessment or advice on driving, and had been considered fit to drive. Those with major higher cortical deficit who failed the overall assessment were excluded. The patients were split into two major groups:

(1) 11 subjects with non-neurological disorders aged 15 to 53 years, average 30 years, S. D. 15;

(2) 40 subjects with neurological disorders aged 16 to 78 years, average 37 years, S. D. 21, who were divided into (a) those using foot controls (16 patients average age 36, S. D. 21), and (b) those requiring hand controls (24 patients average age 39 years, S. D. 20).

5. Results

The printout of in-car responses yields information additional to the reaction time. The time spent braking, maximum brake pedal force, velocity of the vehicle, and how long the vehicle took to stop can be determined. Figure 1 shows diagrammatically the printout of brake pressure and speed obtained from 3 subjects typical of (a) a normal response, (b) that found in patients with delayed reactions but normal strength, and (c) that of a patient with normal brain function but with peripheral weakness (which can be compensated by increased power assistance in braking). The discontinuity on the brake pressure curve indicates the launching of the dog in front of the car. Reaction times are measured from this point. Each symbol represents 80 milli-seconds elapsed, from left to right.

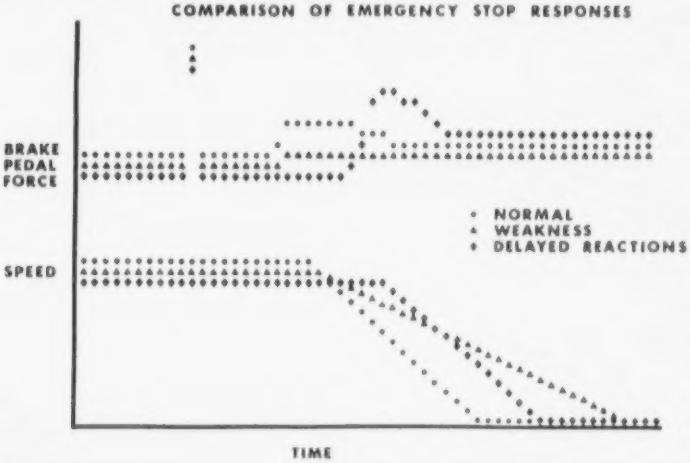

Figure 1: *Diagrammatic representation of computer printouts showing examples of in-car emergency stop responses.*

The reaction times on the test rig obtained in the two ways were compared with the in-car reaction times for each group of subjects using the Microstats package on an Apricot microcomputer. The Wilcoxon Rank Sum Test was used to determine the probability of the hypothesis that the group average reaction times were the same. Table 1 compares the in-car and test rig reaction times with the light stimulus fixed for the various groups, and Table 2 compares the in-car reaction times with test rig reaction when the light position varied. There is no significant difference between the simulated and realistic emergency stop responses for the normal or non-neurological groups. There is, however, a significant difference between the results obtained in both neurological groups.

6. Conclusions

In-car reaction time testing gave no additional information on reaction to an emergency stop in the normal and non-neurological patients. The difference between the in-car testing and the test rig results obtained with both groups of neurological patients however indicates that

Table 1: *A comparison of test rig (position of light stimulus fixed) and in-car emergency stop responses*

	Reaction Times (1/100s)			
	N	Test rig (light fixed)	In-car	P
Normals	59	50 ± 6	58 ± 18	NS
Non-neurological	11	68 ± 18	75 ± 25	NS
Neurological (foot controls)	24	57 ± 9	77 ± 18	0.0001
Neurological (hand controls)	16	52 ± 10	76 ± 23	0.0005

Table 2: *A comparison of test rig (position of light stimulus varied) and in-car emergency stop responses*

	Reaction Times (1/100s)			
	N	Test Rig (light varied)	In-car	P
Normals	59	58 ± 8	58±18	NS
Non-neurological	11	72 ± 16	75±25	NS
Neurological (foot controls)	24	62 ± 10	77±18	0.0006
Neurological (hand controls)	16	58 ± 8	76±23	0.005

with these patients it is desirable to perform an in-car test. It should be remembered, however, that reaction times are only part of the overall assessment, and it is seldom possible to decide on a subject's fitness to drive only on the basis of reaction times. This is, however, relevant information which can be considered along with the other results gathered in the assessment process and a decision on what advice to give to a partiuclar patient made in the light of all of the available information.

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Mobility training following brain trauma – Results of intensive individual treatment

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1. Introduction

The situation of physically handicapped children, adolescents and young adults at school and in vocational training is worse than it need be due to a quantitative and qualitative lack of motor activation and buildup of physical stamina.

Concentrated rehabilitation measures for adolescents and young adults are usually terminated too early. We assume that the responsible orthopedists and neurologists have no confidence in the small steps of motor learning over a long period of time and that they do not realize the significance of permanent motor training. We believe that the use of aids is usually proposed too early and to the exclusion of other alternatives.

We further notice that the families of brain injured individuals are insufficiently informed of the necessity, the extent and the correct way of motor activation. The individual need for guidance is rarely determined precisely and translated into behavioral and activity instructions for the related persons and therapists. As a result in most cases the physically disabled do not get systematic stimulation for motor learning and adaptation after being discharged from institutions of medical rehabilitation.

The provision of disabled individuals with aids at the place of work is commendable; it is doubtful however that these can replace prolonged or even lifelong motor exercises and training. We recommend such prolonged somatic and psycho-motor rehabilitation as a means of increasing and stabilizing mobility. The required periods cannot be generalized. They must be tailored to the specific situation and the individuality of the disabled person. Since it is difficult to anticipate the consequences of an impairment and the personal development (Dordel, 1981), greater flexibility in determing time of care is necessary.

This demand should not only be considered from moral and humanitarian aspects, but the financial authorities should be aware that premature vocational training and resettlement after inadequate somatic and psychomotor development are not worthwhile since the persons will soon have to leave their jobs because of increased health problems or psychosocial difficulties in the vocational and private sphere.

2. Targets, methods, results of intensive motor training – Case studies

We have for many years made good experiences with motor training for physically disabled people in cooperation with their families and physiotherapists. For some time we have now been involved in temporary intensive programs of motor exercises and training for persons after brain trauma. We study the practicability and the effects of such methods in the overlapping areas of therapy, physical education and sports as prevocational, vocational and social rehabilitation measures.

In the following, the results of 2 case studies are described:

(a) Case 1 concerns a young woman, 23 years old, traffic accident 6 years ago. The consequences of the accident were judged as moderately severe with poor chance of improvement when she was discharged from the hospital. The psychomotor situation was characterized by severe ataxia and by athetotic dysfunction mainly of the arms. She was not able to stand without support and to walk without guidance. She also had difficulties in using the wheelchair. Also present were a speech defect as well as problems of visual perception and general orientation.

The training took place concurrently with a prevocational course and was partially coordinated with it. It lasted about 7 months and consisted of 225 hours of motor exercises involving 8 hours per week. In addition, 32 hours of speech therapy were provided.

(b) Case 2 concerns a young man, 22 years old, traffic accident 10 years ago. He was totally dependent on the wheelchair and used an electric wheelchair outdoors. His stato-kinetic condition was characterized by partially controlled spasticity of arms and legs and severe muscle contractions in the regions of shoulders, arms and legs. The total kyphotic and scoliotic vertebral column obviously interfered with the ability to stand freely. Only a period of 10 weeks was available as the young man started a prevocational course in another town. Our training program consisted of 108 hours of motor exercises, 20 hours of physiotherapy, and 65 hours general mobility training including housekeeping and the use of public transportation, shopping, visits to restaurants, museums and so on. In all, he underwent 193 hours, almost 20 hours per week. Our client was furthermore encouraged to pitch in at home in order to relieve his family and to become more independent.

Physical exercises and mobility training were in each case adjusted to the specific situation. We preferred complex functions which demanded and exerted the whole person. In general, we offered dynamic physical exercises with the exception of some forms of muscle stretching where we usually prefer slow continuous and static work. The degree of difficulty was adapted to the individual and actual capacity of motor control. So we could avoid failures and interruptions because of spasms. Motor learning, exercise and training involved various forms of indoor sports and gymnastic exercises with and without equipment, ball games and dancing. Special walking exercises and everyday-oriented mobility training were essential parts of the program, e. g. sitting on the floor and getting up, climbing over different obstacles, transporting objects, falling exercises in diverse situations. An important aspect was cycling on a bicycle ergometer and outdoors on a tricycle. Swimming exercises took up the greatest number of hours of the moter program in each case.

Some important results, which could be well recognized by the participants and by outside observers, had been the following:

- Both clients learned standing without support and free walking over a series of distances of about 3–5 meters from one supporting point to another, as it is necessary and useful in an apartment or at the work place. They managed even to walk more than 20 meters without a teacher nearby by dint of extraordinary concentration;
- they learned to stand up from the floor, and to keep balance or start walking at once. This shows that we first concentrated upon techniques of simple coordination and let them become more and more complex. At the end, both clients had developed the ability of successive and simultaneous coordination to some extent;
- both increased their dexterity and the precision of hand movements. This was probably greatly helped by training in several swimming techniques, in exercises with different balls with partners, and last but not least in the really stressful activities of housekeeping. Both clients relearned swimming and diving without anxiety by means of the natural method.

The general characteristics of our work are summarized as follows:

(1) The exercises were predominantly offered in the context of complex motor tasks, partial movements were performed only occasionally.

(2) We built on the fine remainders of formerly known and mastered movements and tried to make the disbled persons aware of them. By this method, we activated the impaired motor memory and enhanced the process of motor learning and adaptation.

(3) The clients were motivated to exert themselves by the committed work of the teachers and the continuity of care.

3. Experimental control of the motor improvements

In our study we were particularly interested in documenting the effects of the activation measures taken. We used video controls, anthropometric measurements, bicycle ergometry, and mainly light track recording of simple movements with relevance for everyday life. Some of the results are as follows:

3. 1 The development of both persons proceeded in principal in a similar way, with some quantitative differences only. At the beginning only low physical loads could be employed because of the enormous muscular tensions, spasms or athetotic dyscoordination. Consequently the cardiovascular stimulus was low. In our example (Fig. 1), the male client started with a heart rate of 156 at the beginning of the ten week training period. Load and cardiovascular training could only be increased in line with the slowly improving motor capacity in general so that he attained a heart rate of 196. This corresponds to a mean work load (W/min/HR) over 15 minutes, which was about 34 % higher than 10 weeks ago, considering the better performance in the control test as 100 % and interpreting it as the "real" endurance capacity. Consequently, this improvement does not permit a statement about the cardiovascular training. Only continued training on the basis of the now attained coordinative capacity for some time and another test might have shown a real training result – possibly with a reduced heart rate and an increased working capacity.

3. 2 Photographic anthropometry revealed distinct postural improvements as a result of better motility, strength and coordination. The different photographs with lateral (Figs. 2 and 3) and rear view (Fig. 4) demonstrate in each case the postural state after a static muscular tension over a period of 1 minute according to the MATTHIASS-test. In the control tests, we found a more erect posture because of an increased straightening of the big

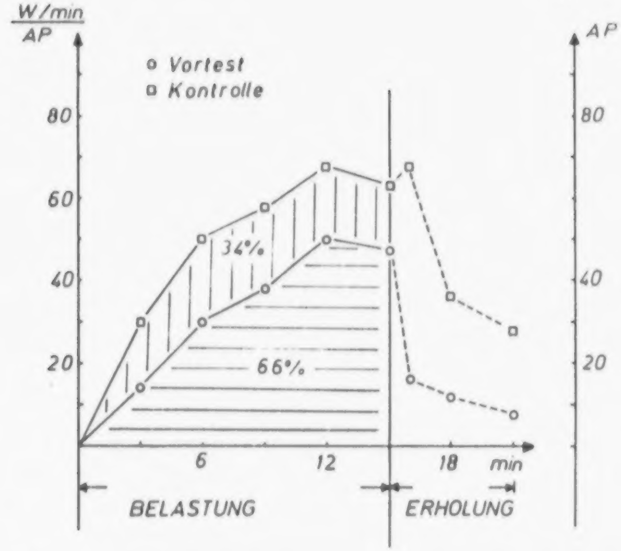

Figure 1: *Results of the endurance test on the bicycle ergometer before* (o–o- - -o) *(Vortest) and after* (□–□- - - □) *(Kontrolle) the period of 10 weeks of intensive motor treatment (male).* AP = working pulse; heart rate over the starting level evaluated in the working phase (= Belastung/load) and afterwards, with 1 minute of active and 4 minutes of passive relaxation (= Erholung). The load was increased stepwise every 3 minutes by about 10 W, beginning with 10 W till the break-off at 50 W and a heart rate of 156 after 15 minutes working time. In the control test the load could be increased by 20 W per step beginning with 30 W; the person reached 110 W after 15 minutes corresponding to the heart rate of 196.

On the left side of the figure the working load per heart beat per minute is documented. The graph shows that the load in the preliminary test is about 34 % lower than in the control test, when the state after the training period is set as 100 %.

The curves in the right side of the graph, which show the working pulse in the relaxation phase, are comparable only with reservation, because the higher working pulses in the control test correspond to the preceding higher load as a result of improvement.

joints and the vertebral column. The motility and strength of the upper region of the body after training is demonstrated by Figure 5, A and B. The slightly raised symmetry in the frontal plane seems to correspond with a better distribution of weight on both legs and with a certain lessening of the scoliotic curve of the vertebral column (see Fig. 4). We found that the body height of the young man standing upright had increased about 2 cm.

3. 3 Particularly interesting are some details of qualitative motor improvement which we controlled by means of the light track recording in various simple exercises:

(a) Example: "Raising the more disabled arm and grasping an object". As the photographs in Figure 5, A and B, and the graph in Figure 6 show, the grasping action became more precise, more fluent and quicker as a result of the motor training. In the case of the athetotic and ataxic woman, the main success lies in the fact that she learned to control the series of oscillating impulses while slowing down the grasping movement (see Fig. 6). The gain of precision and economy is illustrated by the planes which are outlined by the light-marked points on the wrist, the elbow and the shoulder (Fig. 7). In the control tests, the planes became smaller because of more direct grasping.

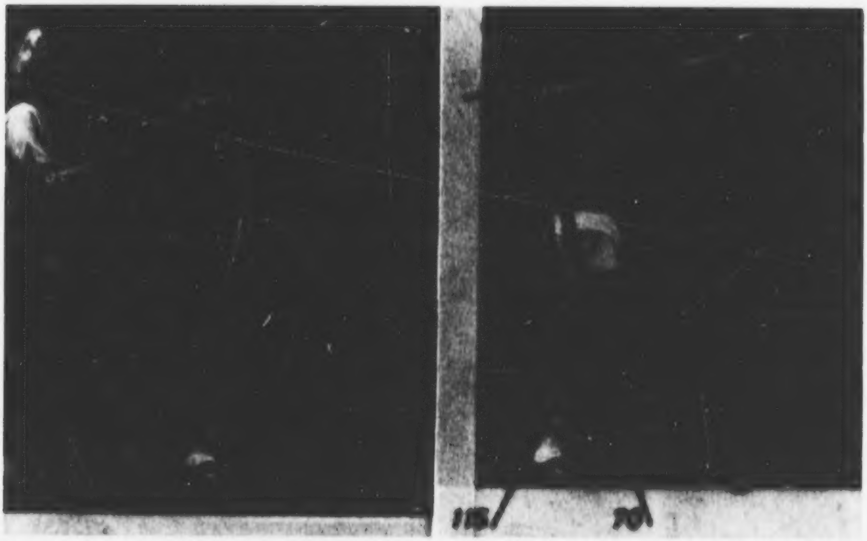

Figure 2: *The postural state after standing upright with arms held in front for a period of 1 minute according to the MATTHIASS-test.* A – preliminary test; B – control after 10 weeks. The changed values of the angles reveal the improvement of motility in the big joints and the vertebral column as well as the strength of the muscles.

Figure 3: *The postural state after sitting upright with arms extended and lifted extremely over 1 minute.* Changes after the training period are especially visible in the more handicapped left arm, but also in the right arm. Further details see Fig. 2.

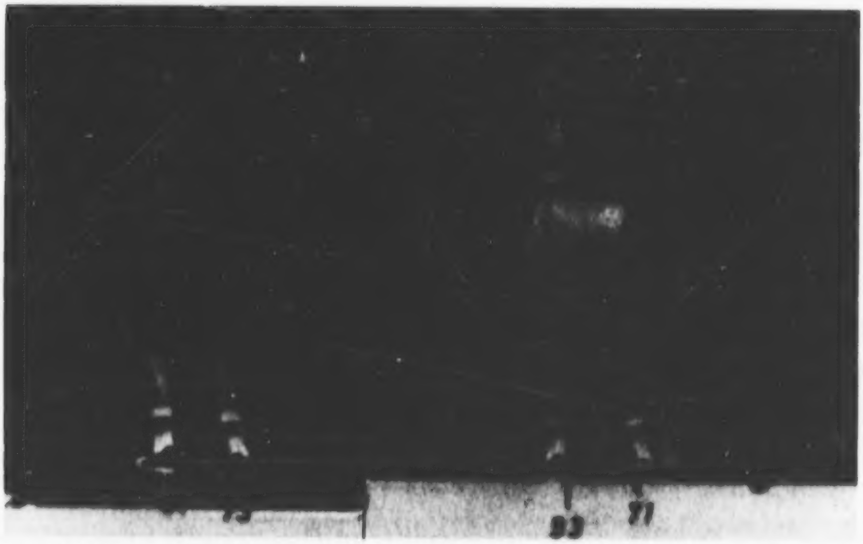

Figure 4: *The postural state after standing upright with arms held in front, elbows bent, for a period of 1 minute.* The dorsal view shows the general postural problems in the frontal plane as well as the improvements after the intensive motor treatment for about 10 weeks. The better symmetry of the body in the control test (B) corresponds with the fact that the body hight increased by about 2 cm and that the person no longer needed someone for security as in the preliminary test (A).

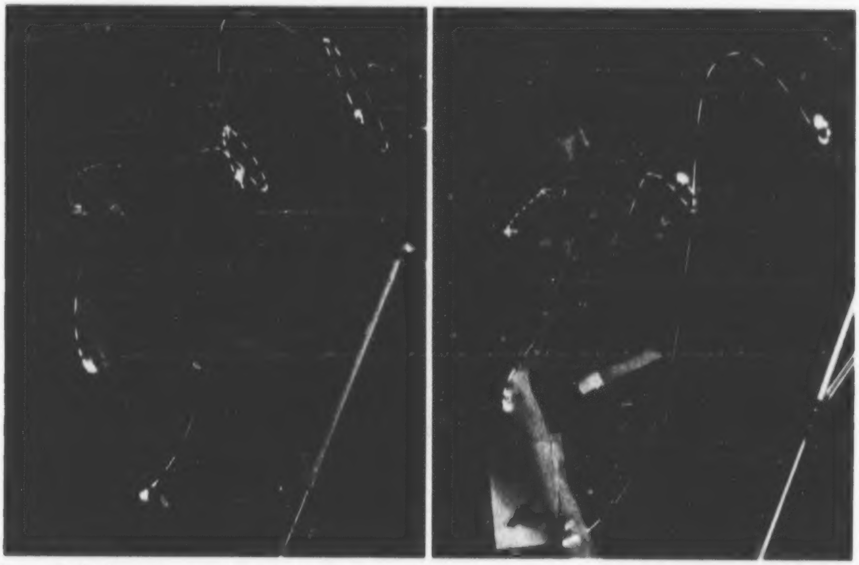

Figure 5: *Light track recording of the test "grasping an object".* A = preliminary test; B = control test. A light and a dark phase together mark an interval of 20 H. (= 0,05 sec). Comparing both photographs, the more direct and more precise movement of the hand, elbow and shoulder in the control test becomes visible.

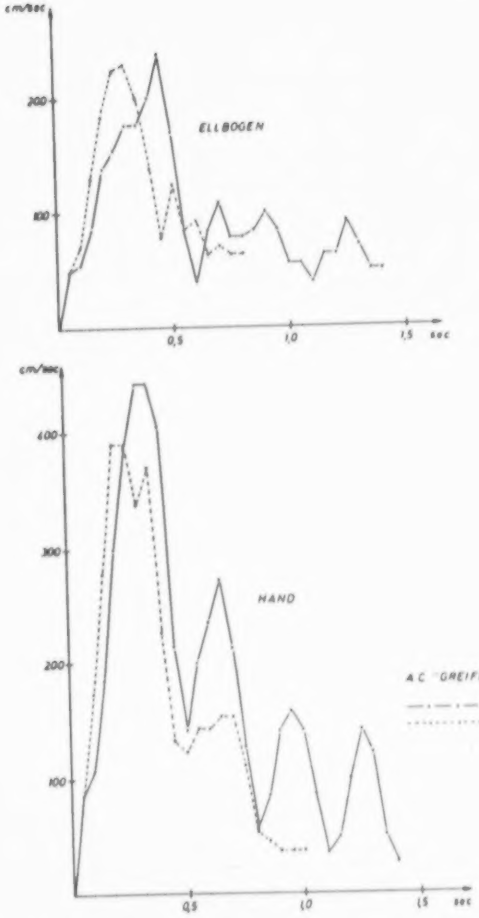

Figure 6: *Light track recording of the test "grasping an object"*. Evaluation of the speed of the movement on the base of the results in Figure 5. The analysis shows that the performance time is reduced obviously in the control. Comparing the preliminary and the control tests, the improvement of the motor quality becomes visible in the disappearance of the athetotic oscillations in the phase of slowing down the grasping movement.

(b) Example: "Sitting up from lying on the back with fixed legs" (Fig. 8). The time of performance is reduced from 3 seconds to 1.25 seconds (Fig. 9). The laborious and tortured movement in the first test had developed into almost dynamic and easy action after the period of motor support.

(c) Example: "Standing up from sitting on a chair with the hands holding the edge of the table" (Fig. 10). The discontinuity of acceleration in the preliminary experiments because of tenseness or problems of balance was no longer found in the tests after the training period (Fig. 11).

(d) Example: "Catching the ball with both hands" (Fig. 12). We are also interested in the special effect of complex and variable training upon the contralateral coordination. We control the performance of the more disabled arm in a simple motor act involving both arms. The clients have to catch a soft pendulum ball with a diameter of about 20 cm. Speed and trajectory of the ball are reproducable. Figure 12 shows the original light track in one of the

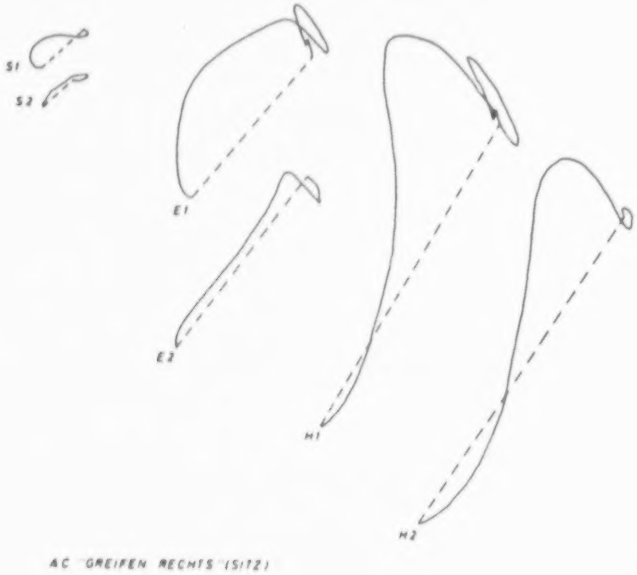

Figure 7: *Outlines of the grasping movement (see Fig. 5 A, B) before and after the intensive motor treatment.* The diminuation of the planes, produced by connection of the starting and the end point (dotted line), is a quantitative proof for the qualitative improvement in terms of increased motor precision, harmony, isolation and economy. S = shoulder, E = elbow, H = hand.

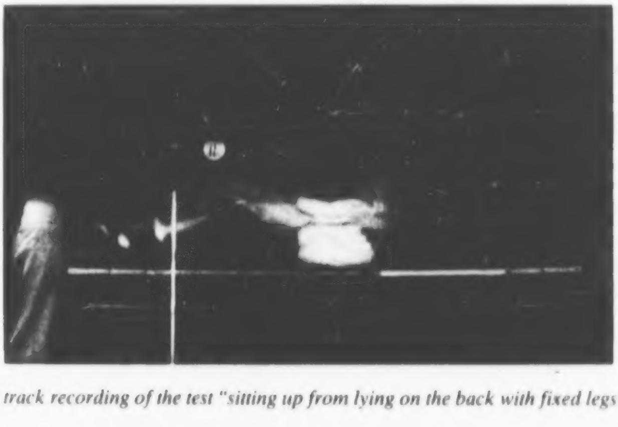

Figure 8: *Light track recording of the test "sitting up from lying on the back with fixed legs" (control test).*

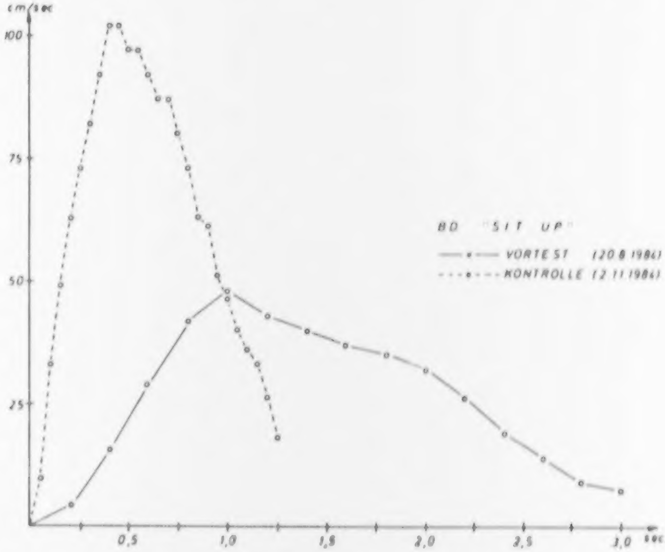

Figure 9: *Light track recording of the test "sitting up from lying on the back with fixed legs" (evaluation).* One light/dark phase = 20 H. The movement in the control is characterized by higher speed and more dynamics.

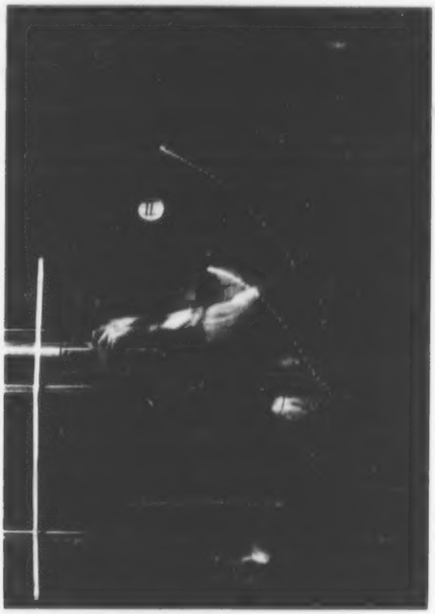

Figure 10: *Light track recording of the test "standing up from sitting on a chair" (control).*

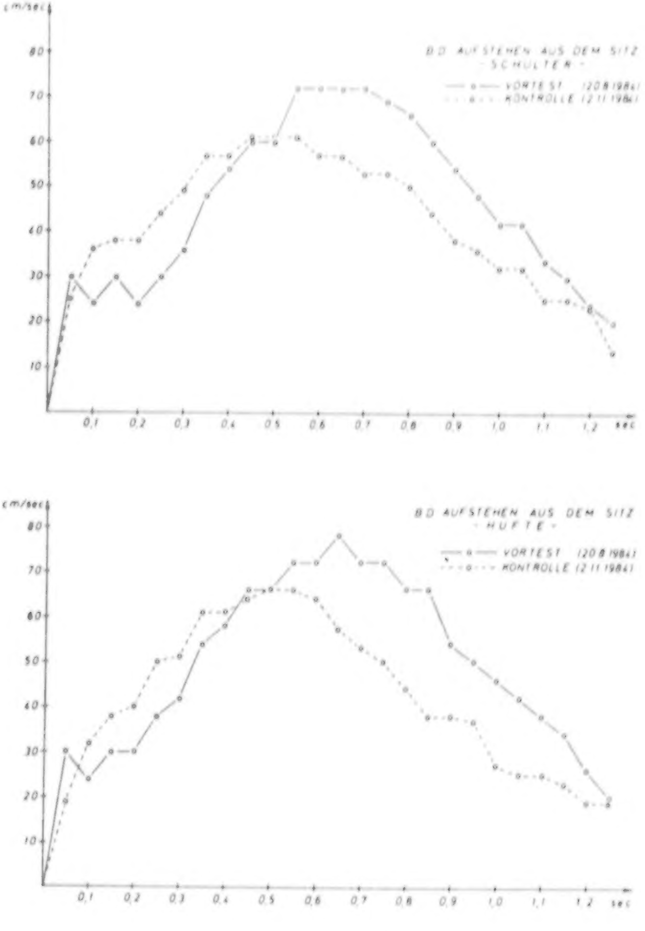

Figure 11: *Light track recording of the test "standing up from sitting on a chair".* Evaluation of the movement of the light-marked shoulder (Schulter) and hip (Hüfte). The more even and economical curve in the control test is the result of better balance and of better control of the sceletal muscles in general.

preliminary experiments. The analysis in Figure 13 reveals that the lifting movement of the more paralyzed left arm visibly slowed down in the first phase of the act and seems to find its real start with a delay of half a second. The less handicapped right arm shows a different activity by accelerating continuously after a better reaction. Ten weeks later the weaker arm has a prompt reaction, followed by an even acceleration to the maximum of 220 cm/sec. Now the stronger arm starts with an obvious delay, as if it were waiting for a while. The nearly parallel course of the curves after half a second suggests increased contralateral coordination.

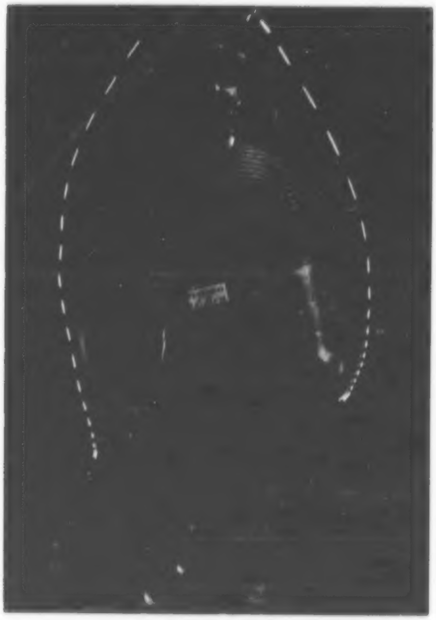

Figure 12: *Light track recording of the test "catching a ball with both hands" (preliminary test).* Left hand is more handicapped by spasm.

4. Conclusion

In conclusion we want to draw attention to two aspects:

- Persons who suffer from severe physical and psychomotor changes of their personality as a result of brain trauma need support for a long time – possibly for their whole life – in the form of motor activation, which should go beyond the usual measures of physiotherapy in extent and intensity. Even when deficits in general mobility, and postural and psychomotor problems become noticeable after a longer period following the accident and the first measures of rehabilitation, we anticipate good results from intensive physical learning, exercise and training.

  With certain reservations, we must admit that complications on the psychosocial and intellectual side requiring more personal guidance will affect the goals and methods as well as the chances of success of the mobility training.
- Improvements in the field of motor control and performance including postural aspects can be quantified by several wellknown means and methods. Especially our light track recording method, which we have introduced in the field of motor training of the disabled several years ago, provides interesting means for qualitative objectivation of motor progress. We propose further development and use of this method as a regular means of diagnosis and control of efficacy for different measures of motor support and therapy in rehabilitation of the physically disabled.

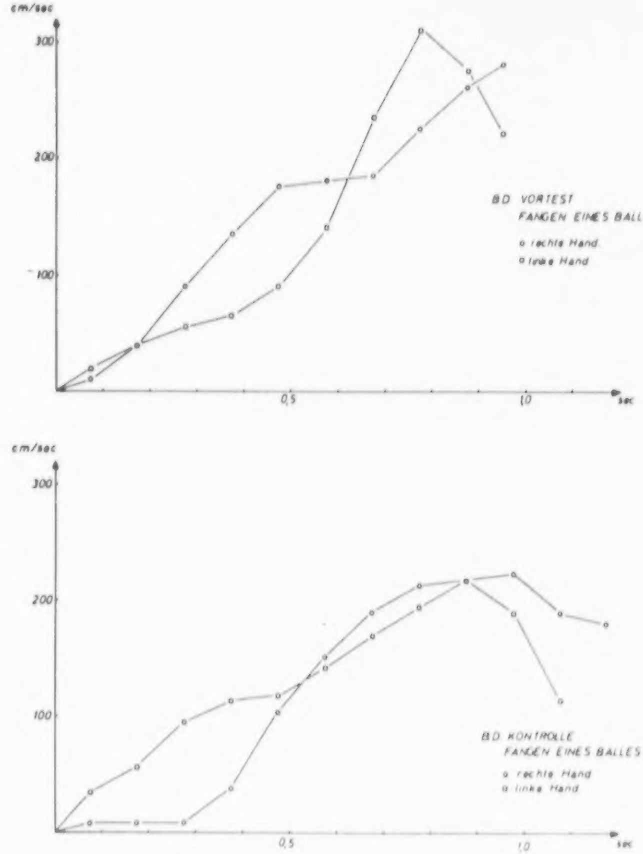

Figure 13: *Light track recording of the test "catching a ball with both hands".* Evaluation especially under the aspect of contralateral coordination. Left hand is more handicapped. The comparison of the graphs above and below as a result of contralateral adaptation shows a parallel course of the curves in the second half of the action, which is the important phase where the ball must be grasped. Further interpretations see in the text.

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Prediction of the range of hand positions available to a patient with movement restrictions at the joints of the upper limb – A mathematical model

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1. Introduction

> *"We submit that functional measures that can be linked fairly directly to underlying impairments in the range of motion probably represent an attractive but somewhat neglected approach to patient assessment, and one that is at once more relevant to the goal of clinical activities"*
> *Badley and Wood (1982)*

The functional capacity of the upper limb depends not only on the function of the hand, but also on the condition of the shoulder, elbow and wrist joints. These joints act in varying combination to place the hand in the appropriate position and orientation to undertake its skilled tasks. If the joints are affected by disease, for example rheumatoid arthritis, then functional incapacity of the limb may result. A direct measurement of limb function is seldom made clinically; usually only the range of movement possible at each individual joint is assessed.

At present few data are available on this subject. From a clinical viewpoint, a major hurdle has been the difficulty of describing three-dimensional joint movement. While the single axis movement of the elbow can be measured simply, the more complex movements at the shoulder, even if the problems of scapular movement are ignored, are difficult to describe since the traditionally clinical definitions are based on planar movements, e. g. abduction (Kapandji, 1982). It is probably because of these difficulties and of the associated problems of 3-D measurement that this subject has been studied by only a few investigators. The most detailed work was that carried out by Dempster (1955) who was concerned with the range of movements of pilots' arms to assist in the design of aircraft cockpits. He was concerned only with the movement of fit, young males, and not with the disabled population. However, as will be shown later, Dempster's results provide a most useful background to the present study.

More recently, work has been carried out to study the range of movement required at a particular joint when carrying out a range of tasks. Morrey et al. (1981) investigated the elbow joint, using an electrogoniometer, and the results are summarised in Table 1, while Carlson and Trombly (1983) carried out a similar study of wrist flexion/extension. However, no such studies have been carried out on the human shoulder joint; the problems of goniometry with more than one degree of freedom are well described by Chao (1980). It is true to say, therefore, that no work has yet been performed to study the interaction of the different movements or to predict the functional consequences of multiple joint disease. The nearest approach to this so far has been the statistical study of Badley and Wood (1982), which suggests that joint impairment and functional ability may be related.

The authors' objective has been to determine the relationship between the range of movement available at the three major joints of the upper limb and the overall upper limb function. This would be of great use in predicting the effect of various clinical treatments, e. g. elbow replacement, physiotherapy to improve shoulder abduction, arthrodesis of the wrist. (Swanson, et al. 1978, quote figures for evaluating impairment of the upper limb from knowledge of the joint ranges, but their figures have no basis in experimental fact.) It would

Table 1: *Extremes of elbow motion required for selected tasks.* (Morrey et al 1981); *means of 33 subjects.

Activity	*Mean flexion (degrees)		*Mean rotation (degrees)	
	Min.	Max.	Pronation	Supination
Pour from jug:	35.6	58.3	42.9	21.9
Put glass to mouth:	44.8	130.0	10.1	13.4
Cut with knife:	89.2	106.7	41.9	−26.9
Put fork to mouth:	85.1	128.3	10.4	51.8
Use telephone:	42.8	135.6	40.9	22.6
Read newspaper:	77.9	104.3	48.8	− 7.3
Rise from chair:	20.3	94.5	33.8	− 9.5
Open door:	24.0	57.4	35.4	23.4

appear obvious that the greater the range of joint movement, the greater the function, but when dealing with a multi-degree of freedom system such as the upper limb, it is not obvious how the variables are related.

The relationship between joint motion and limb function could be determined by studying normal subjects performing a variety of tasks in order to establish the critical ranges of movement required at each joint during each task. Then, by comparing a patient's joint ranges with these critical values, the feasibility of performing each task could be determined. Summing the feasible tasks would give an index of the patient's upper limb function. However, since the upper limb has at least 7 degrees of freedom and only 6 parameters are required to define the position and orientation of a rigid body, e. g. the hand in space, no unique solution is possible, i. e. placing the hand in a particular position and orientation can be achieved by many different combinations of joint angles. It is thus impossible to define absolute joint ranges for any particular task.

A more promising approach might be to look at the range of hand positions and orientations during the execution of a variety of tasks. These are more likely to be the same from subject to subject. If a method were available by which knowledge of a subject's joint ranges could be used to determine the feasiblity of placing the hand appropriately, then the relationship between joint ranges and limb function could be determined.

2. Mathematical model of the upper limb

The first stage of the research programme has consisted of modelling of the limb as a spatial linkage consisting of 3 rigid segments: the upper arm, the forearm, and the hand. In reality the upper limb and shoulder represent a linkage of much greater complexity than this, but the simplified model is required to make the problem mathematically tractable. This model has 7 degrees of freedom, i. e. 7 different angles must be computed as follows:

Shoulder – Abduction
Flexion
Humeral external rotation
Elbow – Flexion
Forearm – Supination
Wrist – Dorsi-flexion
Radial deviation

These angles are calculated using the methods of Benati et al. (1982). As has already been discussed, the presence of 7 degrees of freedom means that there is an infinite number of ways of positioning the arm for a given hand location. In practice a range of arm configurations, limited by ranges of joint movement and bodily obstructions, can be used as can be illustrated by noting the elbow movement which is possible while the hand and shoulder are maintained in a fixed position. The possible arm positions are those which satisfy the following criteria:

(1) The distance from the shoulder to the wrist is less than the sum of the lengths of the two proximal segments.

(2) All of the 7 angles lie within the clinically measured ranges.

(3) None of the segments collide with the body.

Using this program the feasibility of any hand position and orientation may be determined. By computing the feasibility at discrete intervals within a cube of side 2 L (L is the total arm length) centred at the shoulder, it is possible to identify the spatial points accessible to the hand with a particular orientation. "Workspaces" can then be produced from the accessible points in each slice as shown in Fig. 1.

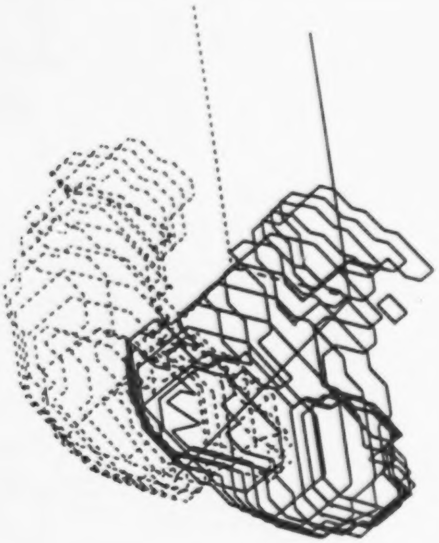

Figure 1: *Predicted workspace produced from individual slices*

Since the model contains many assumptions, particularly those relating to shoulder movements, it is important before examining patient data in detail, to compare predicted workspaces with experimental data. For this purpose the authors have considered the work of Dempster (1955) who determined the workspaces of pilots seated in a standardised position. The subjects were asked to trace out the areas accessible at different distances in front of them while maintaining the hand in a fixed orientation. The areas traced correspond, therefore, to the slices calculated by the predictive model. Since all of the segmental data used for these calculations correspond with those of Dempster, a valid comparison can be made. The areas of workspace within the slices have been compared (Figs. 2–4) as well as the total volumes (Table 3) for three different hand orientations: forward pointing and in the prone, neutral and supine positions.

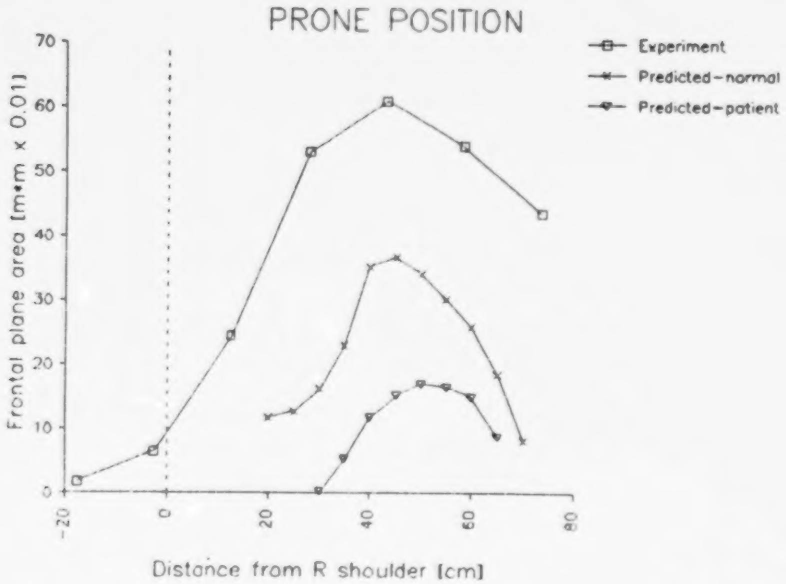

Figure 2: *Variation of workspace area with shoulder distance (prone)*

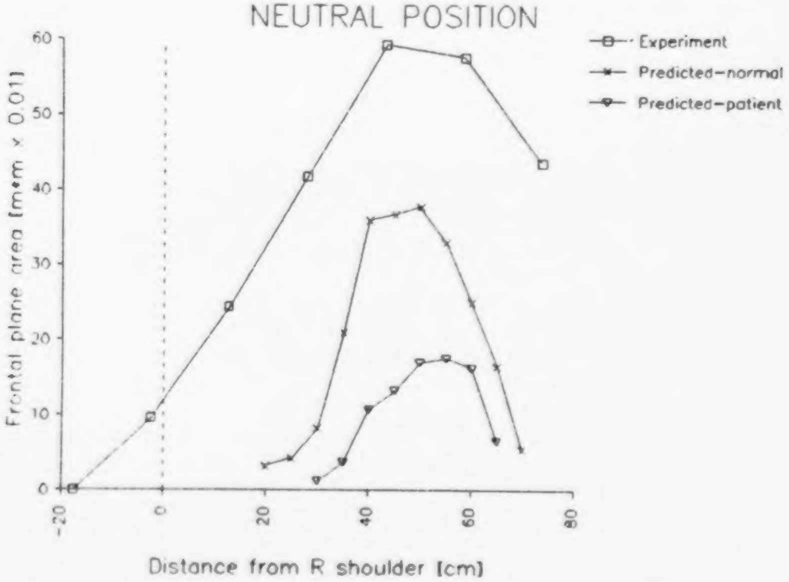

Figure 3: *Variation of workspace area with shoulder distance (neutral)*

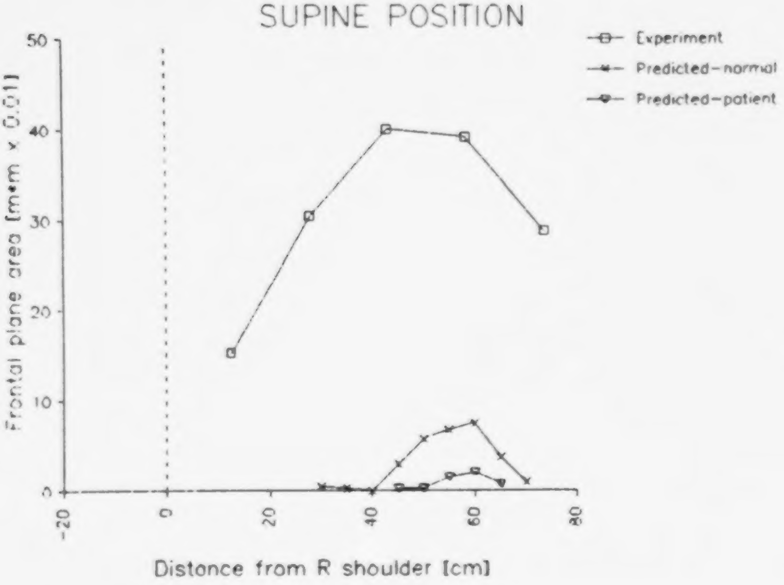

Figure 4: *Variation of workspace area with shoulder distance (supine)*

It will be noted, in particular, that the total volume determined experimentally is considerably larger than that predicted; there are also marked differences between the area versus distance curves. While the segmental data used in the two studies is identical, the conditions at the shoulder are less well defined. In particular, the 7 degree of freedom model assumes that the centre of rotation of the shoulder joint is fixed. However, in his experiments Dempster did not attempt to immobilise the shoulder although the trunk was constrained. It seems likely, therefore, that scapular movement was permitted during the experiments. The experimental work of Rozier and Faulkner (1975) showed that restriction of scapular movement could reduce workspace volume by as much as 54 %, with the greatest differences occurring in the regions immediately in front of the body and above shoulder height. In addition to the differences in shoulder constraint, the assumed model of the body (see Fig. 5) should also be considered. This model is assumed to consist of regular geometrical shapes and to be rigid. In reality, the body is of a more complex shape than this and is compliant. In addition, there will be variations of body shape between experimental subjects.

The predictive model has also been used with range of motion data collected from arthritic patients at a rheumatology clinic. For illustration purposes, in this paper it has been assumed that the segment lengths are those used by Dempster; the ranges of available motion are listed in Table 2. The graphs of area against distance for one particular patient are included in Figs. 2–4. The predicted total volume is reduced to between 15 % (supine) and 37 % (prone) of that of normals. The loss in the most distant regions may be explained by the patient's fixed flexion deformity of the elbow

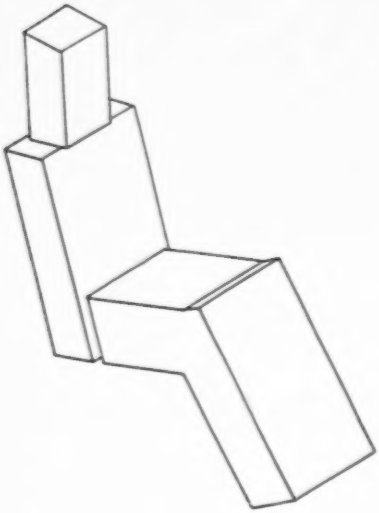

Figure 5: *Assumed model of body for predictive model*

Table 2: *Joint ranges (degrees)*; *normal data taken from Dempster, 1955, Table 5. Average of 11 median subjects.

	Normal*		Patient	
	Max.	Min.	Max.	Min.
Shoulder flexion:	193.2	− 63.0	90.0	−63.0
Shoulder abduction:	132.1	− 50.8	132.1	−50.8
Humeral external rotation:	30.7	− 95.7	30.7	−95.7
Elbow flexion:	141.0	0.0	141.0	80.0
Wrist radial deviation:	25.1	− 46.3	5.0	−25.0
Wrist dorsi-flexion:	94.6	−102.0	40.0	−50.0
Forearm supination:	100.6	− 74.0	100.6	−74.0

Table 3: *Workspace volumes (m^3)*; *experimental data taken from Dempster, 1955, Table 9. Average of 22 median and muscular subjects.

Hand orientation	Predicted normal	Predicted patient	Experimental*
Prone:	0.121	0.045	0.339
Supine:	0.014	0.002	0.216
Neutral:	0.140	0.045	0.327

3. Future work

While the present study has made it possible to predict patient workspaces, the results obtained from normal subjects are significantly different from the published experimental data. Since many of the discrepancies occur in the regions closest to the body, it is believed that improvements could be achieved by incorporating a more accurate model of body contours. It is intended, therefore, to develop the model further by incorporating published anatomical data (Eycleshymer & Shoemaker, 1911).

The clinician and the therapist require to know how their treatment might improve the functional ability of a patient. While the present study may help to understand how the workspaces may be improved by different type of treatment, the data cannot yet be related to the execution of the tasks of daily living. This information can only be derived from the predictive model when the hand orientations and positions required for these tasks are known. The authors are, therefore, embarking on an experimental research programme to gather this data using three dimensional movement analysis techniques. In the longer term it will become possible to build a data base of the orientations and position required for a standard range of tasks. It should then become possible to use this data with the present predictive model in order to relate available ranges of movement to the tasks which can be achieved.

4. Summary and conclusions

A mathematical model has been constructed to predict the workspaces available to patients with reduced ranges of motion at the joints of the upper limb. The model uses the inverse kinematic method of Benati et al. (1982) together with simplified anatomical data. Comparisons with experimental data (Dempster, 1955) show significant discrepancies which are believed to be due to differences in scapular constraint and to simplified anatomical modelling. It is intended to improve the anatomical model by the use of the published data of Eyclesheimer and Shoemaker (1911). Despite the discrepancies, the model already detects significant differences between normal workspaces and those of patients with restriction at the joints of the upper limb. It is believed that this model could, when incorporated with empirical data, form the basis of an „expert" system to assist the therapist and clinician in the planning of rehabilitation of the upper limb.

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A new electronic mobility aid for the blind – A field evaluation

M. Kumpf, Marburg (Fed. Rep. of Germany)

When one sees blind persons in surroundings not familiar to them, one will observe that practically all use one of the following methods to move about: They have a sighted human guide, a dog guide, or a cane. Today, the long cane is widely accepted as the most efficient mobility aid for independent travel (Farmer, 1980). The long cane does, however, have a distinct disadvantage: It fails to provide its users with reliable information about obstacles outside the reach of the cane, and thus does not enable them to avoid collisions with those obstacles. Such obstacles may be branches, signs, or any other object protruding into the path above the waist.

Within the past 30 years, quite a number of attempts have been made to develop electronic mobility aids that overcome the shortcomings of the long cane. Most of these devices have not survived the prototype and field testing stages. With few exceptions, they were not intended to replace the cane, but to be used in addition to it. The common underlying principle of these aids is to provide ongoing information about obstacles and other relevant features of the environment. Most devices emit infrared light or ultrasonic signals, which are reflected from objects. The reflections are electronically converted, and the converted reflections indicate to the users if there is something ahead of them. To give an example: The Sonicguide, one of the more successful electronic mobility aids, emits ultrasonic signals. Their echoes are converted into audible information, with time and loudness differences between the left and right ear indicating the direction of an obstacle, the pitch indicating distance, and the timbre indicating – within limits – the nature of the surface from which the signal has been reflected.

If this sounds complicated, this is because it actually is complicated. Would it not be easier for blind persons to work with information of a kind that they use anyway, namely unconverted echoes of audible signals? One can fairly often see blind persons intentionally producing sounds in order to make use of the echoes, e. g. by snapping fingers, or by clicking keys against one another, or by tapping the cane while standing still. Why not build a device that would automatically and continuously produce sounds, which are then reflected from objects in the path of the blind pedestrian?

This, in part, was the rationale behind the development of a new mobility aid, conceived by a physicist at the Battelle Institute in Frankfort, Dr. Karl Beuter. Preliminary test devices were built by Sennheiser electronics, and the German Institute for the Blind in Marburg conducted an independent field evaluation.

Our test devices were rather cumbersome. The apparatus is 190 mm high, 110 mm wide, and 60 mm deep. A plastic cone with a length of 125 mm and an aperture diameter of 155 mm is mounted around the small loudspeaker on the front of the box. The travel aid is worn on the chest and held by two straps. It runs on rechargeable batteries. The "click-sounds" generated by the device are frequency-modulated FM signals with a duration of six milliseconds, at a rate of up to 2.5 signals per second, and with an intensity of up to 70 decibels. Both signal rate and intensity can easily be adjusted by turning their respective dials on the top of the box. The maximum intensity is lower than that generated by the long cane when it contacts a hard surface in the course of normal travel.

According to plans made before the results of our evaluation were at hand, the final product was to be technically identical but much smaller than the preliminary devices we had originally at our disposal. The projected price was considerably lower than the cost of the technically much more sophisticated aids mentioned above.

Our evaluation was designed to obtain measures of the actual and perceived usefulness of the device under realistic conditions. We began with the selection of suitable subjects, obtained baseline measures of their mobility performance, and formed two comparable groups on the basis of these performance scores. One of the groups then received instruction in the use of the device, the other served as a control group. After completion of the training, all subjects covered two standard routes twice, and we again measured their mobility performance. In addition, we conducted extensive interviews with our subjects at three points during the training phase, and also after the final mobility tests.

The subjects entering into our final analyses were 24 fully blind students between the ages of 17 and 21 years, who were enrolled at the school of the German Institute for the Blind. All had normal hearing and had previously completed training in orientation and mobility. Twelve subjects were trained in the use of the device while the others served as controls. Training was limited to twelve hours, substantially less than is required for other electronic travel aids. Since one of the alleged advantages of our device was the small amount of training needed, we put this claim to a severe test.

After the training was completed, our subjects walked the two courses that we had laid out for them. One of the courses led through three floors of a university building, the other through five adjacent streets in Marburg. The course in the building had a length of 145 meters, and the course outside covered a distance of 1150 meters. We complicated the task by setting up specially constructed obstacles, thus giving the device a chance to prove its usefulness. Among these obstacles were signs protruding into the path at about the height of the head, large metal barriers for construction sites, garbage cans, direction arrows, boards, and round cardboard posts.

The subjects walked both routes twice, with the trained subjects using the mobility aid on one of the two trials (half of the group on the first trial, the other half on the second trial), and the control group using solely the long cane on all trials. The experimental design thus permits to assess the effects on mobility performance of three different factors: training, practice, and the new device. On their rounds, the subjects were filmed by a cameraman trailing them at a distance of approximately 5 meters. The recordings constitute the basis for our analysis of mobility performance.

The dependent variables, and results obtained can only be summarized briefly here. We defined our subjects as "mobile" to the extent that they were able to walk a defined route without assistance, quickly, safely, and gracefully (Foulke, 1971, 1982). Another undoubtedly important criterion, i. e. stress, was not measured objectively via physiological measures, but subjectively through self-reports. The indicators for the first three dimensions of mobility performance were as follows:

Dimension:	*Indicator(s):*
Speed:	Time in seconds for the defined course
Safety:	*Scored positively:* Number of defined obstacles detected without cane or body contact
	Scored negatively: Number of: unintended body contacts with objects of any kind; defined obstacles "detected" through unintended body contacts; deviations from the prescribed course; tripping, stumbling, etc.; dangerous situations

Elegance: Number of cane contacts with the shoreline, fluctuations between shorelines ("zig-zagging")

The indicators for speed, safety, and „elegance“ were assessed by two trained judges who viewed the recordings independently. Since the judges could obviously not be blind as to the experimental condition (use of the device vs. non-use), precautions were taken to minimize rater bias.

In presenting the results, we focus on the effects of the device, disregarding training and practice effects. First of all, we found that use of the mobility aid did not shorten the travel time. There were, however, some significant effects relative to our "safety" measures: When they used the device, subjects detected more obstacles without cane or body contact ($p < .01$), and had fewer collisions with them ($p < .02$) than when they walked without the mobility aid. This was true both for the routes inside and outside, but the positive effects of the device were more pronounced for the route outside. There were no significant differences between the groups on any of the other safety measures. As for "elegance", we found that the number of cane contacts with the shoreline was significantly lower when the mobility aid was used, indicating that the subjects relied less on shoreline contact for orientation. On the other hand, subjects also fluctuated more often between shorelines when they wore the device, and this seems to indicate a less "elegant" style of traveling. Taken together, these results demonstrate that the new device does improve the detection of obstacles while they are still out of reach thus increasing safety, that it does not affect walking speed, and that traveling appears to be more elegant in one respect and less elegant in another.

In spite of these objective positve effects of the mobility aid, our subjects showed only very restrained enthusiasm, to put it very mildly: Only one of the twelve subjects who had learned to use the device expressed an interest in keeping it for further use. In addition to the universal rejection of the appearance of the mobility aid as it looks now, there were objections that may be harder to overcome: All subjects said that the clicks, and consequently the echoes, were not loud enough to be of use when the environment was not quiet, and that they did not think that their performance was affected positively to a degree that would justify the inconvenience.

Our conclusion is that the device will not be a success among blind persons if no dramatic improvements beyond mere miniaturization are made. There have been many well-intentioned attempts in the past to construct electronic mobility aids for the blind, and some have even been very similiar to this one. If very few of these aids have entered the production stage, it is because most inventors simply do not know enough about the cognitive processes involved in mobility (Brabyn, 1978; Strelow, 1985), the needs, the likes and dislikes of their potential customers – and about their predecessors' failures. An evaluation study such as this can serve the purpose of re-directing effort before an undue amount of money has been spent. In this concrete case, there is reason to expect that the results will indeed profoundly influence upcoming decisions.

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Walking restoration for complete adult thoracic lével paraplegics

J. H. Patrick, Oswestry (United Kingdom)

– Brief summary –

Our Unit, funded by the Department of Health and Social Security, has been investigating the possibilities for paraplegic walking for more than ten years. The initial orthosis (splint) worked well for children with congenital paraplegia (myelomeningocele) and depended for its success on providing a rigid splint with a patented hip joint which provided guidance to the swing leg (the hip guidance orthosis). Reciprocal walking is less energy consuming than 'swing through' paraplegic walking is, and is an essential part of the system. In fact, when we proceeded to use the orthosis for adult traumatic thoracic-level complete paraplegics, we realised that the Energy Requirement for this orthotic walking system is high. We tried to make the splint (now called a 'Parawalker') more rigid, but this was less successful than we hoped, presumably because the active shoulder girdle musculature is having to perform anaerobic respiration throughout the walk.

Our next step, begun 2 ½ years ago, was to add an 'electronic assist' to the orthosis – the so-called FES-orthosis hybrid. Our research with 3 walking subjects using the Parawalker has revealed that we can reduce the physiological cost-index and the crutch-force (measured in the Gait Laboratory) by 30–50 % aided by Functional Electrical Stimulation of the stance buttock musculature. F. E. S. is also used to aid transfer to the upright position from sitting, while wearing the orthosis.

Assistive devices – from prototype, to product, to users

J. Batelaan, Scarborough, Ontario (Canada)

Research and development of assistive devices is a satisfying occupation for many technical people because it allows the use of their knowledge and skills to address directly the special needs of their fellow man. For that reason it appears that a disproportionate number of projects at technical universities and colleges are related to assistive devices for the disabled. Also, friends or relatives of a disabled person have built technical aids, some of them quite innovative and practical. This development work is in addition to more carefully directed research and development at several well established rehabilitation centres. In contrast to this relatively prolific development activity, very few assistive devices have passed beyond the prototype stage and made available as a finished product.

The few commercial companies which are in the business of producing and marketing technical aids are usually not eager to take on the newly developed devices. The market for most new technical aids is very small and diffused, at least for the first few years. Therefore, these new assistive devices do not generate enough financial return to cover the costs of product development and initial marketing, or, in other words, they are not commercially viable. Even if the benefits of the new device are well documented and a prototype is offered without financial obligations, there remains a reluctance by the enterprise to make it available in the market place.

For researchers and rehabilitation professionals as well as for the disabled person this situation is very discouraging. It is also an inefficient use of research funding if the results cannot be utilized by many more persons with similar disabilities. To avoid this inefficiency, more funding sources, which in many instances are government agencies, should not only support the research and development phase of new technical aids, but in particular the two phases which follow, i. e. product development and market introduction. These last two phases are usually as costly as the first R & D phase.

A government financed program in Canada has addressed this problem by supporting a small group of product developers and by assisting a marketing company in the introduction of new technical aids (Roy, 1982). I am the Manager of the Rehabilitation Technology Unit (RTU), a group of seven people who are part of the Biomedical Engineering Program of the National Research Council Canada. The large National Research Council (NRC) has most of its facilities in Ottawa. Our small group is located in Metropolitan Toronto where we have a 500 m^2 office and workshop facility. RTU began its work under NRC in 1978, when it was transferred from another government department. A major objective of RTU is to turn prototype assistive devices, developed by others, into completed products which can be manufactured by small companies. This product development work is done at RTU's workshop and under contract by several small local manufacturers.

One year later, in 1979, a marketing company was set up under the direction of a national voluntary organization, the Canadian Rehabilitation Council for the Disabled. The marketing company, called Technical Aids and Systems for the Handicapped, or in short TASH, is a non-profit company with the mandate to market those technical aids that are not available from other suppliers. Until now TASH has received annual grants from the National Research Council Canada to cover the initial marketing costs of introducing new technical aids. TASH orders the technical aids from the various small manufacturers who produce the aids in short production runs of 30, 50, or 100 units. With an appropriate mark up over the cost, TASH will sell the technical aids through dealers or direct to the end user and to rehabilitation centres.

This combined effort of RTU in product development, TASH in marketing, and manufacturers in production has resulted in the introduction of 12 new technical aids which were originally developed by others. In the same six year period, more than 50 accessories to technical aids such as a variety of special switches, mounting hardware, keyboards and unicontrols were developed at RTU. TASH Inc. also sells technical aids from manufacturers who have developed their own products without RTU involvement. Over 100 items are shown in the current TASH catalogue, and a representative selection of the TASH technical aids are on display in stand 7A-30 of REHA 85. Total annual sales is now approaching 1 million dollars.

About fifteen small manufacturers produce the technical aids for TASH Inc. All these companies rely mainly on other work for their income, but they are willing to produce small production runs for TASH at a reasonable cost. A significant part of our work at RTU is to find companies with particular manufacturing expertise and to work closely with them during initial production runs. RTU covers the cost of tooling and purchases the first five or ten units for evaluation purposes. When the production units have been evaluated and accepted, TASH Inc. will purchase a production run from the manufacturer for marketing to the users.

This technology transfer work of RTU has been done without any agreements related to royalties or patents with the original developers. Developers who wish to retain rights to their design or who expect royalties, are referred directly to commercial enterprises. This policy has helped to avoid potential causes for disagreement or dissatisfaction and has limited this government financed program to technical aids which otherwise would not have been introduced to the market. Developers of prototype technical aids who wish to have the aid developed into a product by RTU, are requested to seek third party endorsement for this product development. Persons who were not involved in the original development and who are familiar with alternative aids, are asked to assess the new aid and comment on the value of its features.

This program of technical aid product development and initial marketing support (see Fig. 1 and Fig. 2) is probably unique. It has made a wide selection of technical aids available to the disabled user and the rehabilitation clinician, both in Canada and the United States. It is suggested that similar programs in other countries be established, which will exploit and complement research and development work in their jurisdictions and thereby contribute to a greater international availability and selection of technical aids.

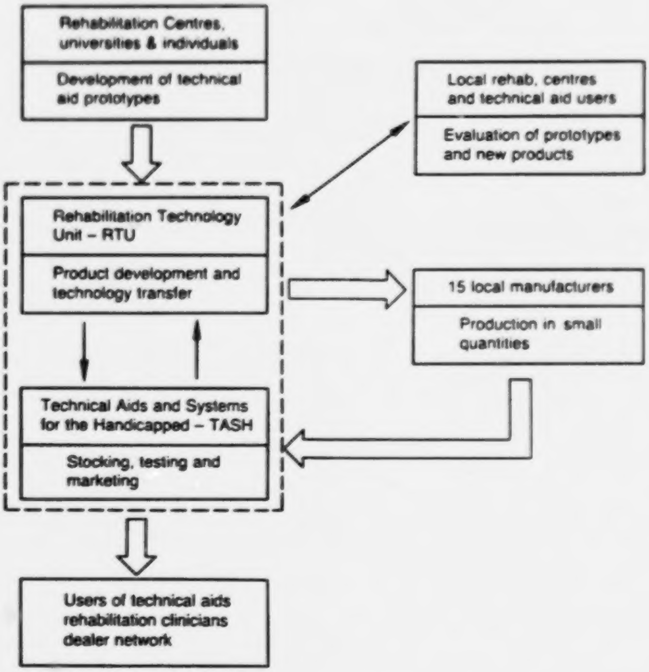
Rehabilitation Centres, universities & individuals
Development of technical aid prototypes
Local rehab. centres and technical aid users
Evaluation of prototypes and new products
Rehabilitation Technology Unit – RTU
Product development and technology transfer
15 local manufacturers
Production in small quantities
Technical Aids and Systems for the Handicapped – TASH
Stocking, testing and marketing
Users of technical aids rehabilitation clinicians dealer network

Figure 1: *Technology transfer model with RTU and TASH*

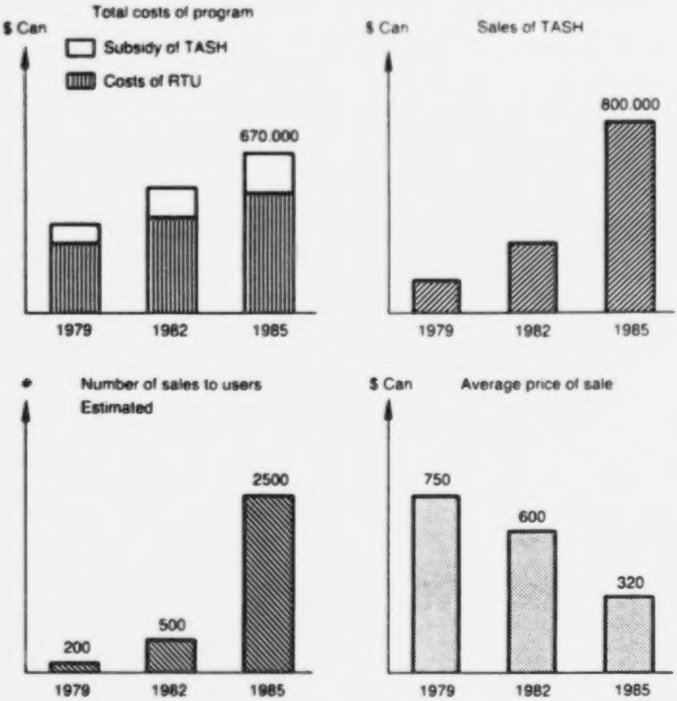

Figure 2: *Costs and benefits of RTU/TASH program*

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Information technology and remote working for disabled people

J. McCann, London (Unit Kingdom)

This paper presents the Remote Work Unit project, a project that is opening up new job opportunities for disabled people using the new Information Technologies.

Frances is one of the people we have set up to work from home. She works for the London School of Accountancy, producing texts for training manuals on a word processor. She has Still's Disease, a form of infantile arthritis, which means that she has difficulty in getting about. Frances had to leave the Civil Service on medical grounds when she was only 30. Without this chance to work from home, which this project has made possible, Frances would have found it difficult to get a real job.

I hope to be able to demonstrate how the mix of Information Technology, remote working and disabled people provides real job opportunities, particularly for people with mobility problems. It was developments in new technology and its application to work which triggered off the idea of mixing Information Technology, remote working and disabled people. 1981 had been the International Year of Disabled Persons, and in 1982 the Department of Trade and Industry (DTI) in the United Kingdom was promoting Information Technology with a host of related activities. One result was a pilot initiative during 1982 to set up six "remote work units for disabled people".

Beverley was one of the first employees to be set up in such a unit, working with a microcomputer doing an examination administration job for the British Computer Society. She works from home in Suffolk where she lives with her parents.

From the very start the signs were good, there were willing employers, suitable jobs which could be done from home, and certainly skilled disabled people looking for paid work. The blend of Information Technology, remote working and disabled people seemed to work. This initial success encouraged the Department to extend the pilot project from six to sixty units, which have now been successfully implemented, involving finding the jobs, the recruits, the equipment and putting them together. From September 1984, and over a period of 2 years, a further 40 units will be set up, again funded by the DTI but this time with matching support from the European Social Fund. The major aim of this phase is to develop guidelines by which this kind of remote working can be incorporated into a permanent scheme within the UK.

I would now like to describe some of the experiences gained so far, in the first 60 units set up, the employers, the people, the jobs, the equipment, and some of the conclusions reached about what seems to work best.

First, the employer, without whom we could not even begin, so finding the employer has been a prime task. Employers heard about the project in a number of ways, some on TV and radio, or from personal contacts, others read articles in the press, and other Government agencies spread the word, too. A complete mix of companies, of all sizes, has been involved, spreading across industry and service sectors. The range is literally from a firm with 10 employees to an organisation with many thousands, the majority of units however have so far tended to be in the small and medium sized companies. Big companies are perhaps a little less excited by the thought of some free technical advice and equipment provided by the project, and decision-making in the larger companies tends to be more complex.

The size and type of company may have varied but what has not is the amount of employer effort needed to make a unit operate well. The vital ingredient has been employer commitment – commitment to the individual worker, and commitment to making the whole thing work. There are clear benefits, too. Employers are saying that they are very happy that they got involved. The cost of running a remote work unit compares favourably with the cost of having a worker "on-site"; productivity rates, too, appear to be on a par with those of "in-house" employees doing similar work.

Here are a few examples of the skills and work experiences of some of the disabled people successfully placed during Phase one. The range was wide. From simple typing to specialist design skills, from an apprentice plumber through to a physical education teacher and an accountant. A simple typing skill has often been enough to make a successful match between candidate and job.

This is a purely subjective and simple way of grouping skills. Under the heading "low-level" we show the number of jobs set up, which principally involved the keying in of data, – simple database updating and invoice preparation are two such examples. "Medium-level" skills describe jobs which involve the manipulation of data-word processing and computerised bookkeeping for instance – there were twenty-seven in this group. "High-level" is used to describe skills where specialist subject knowledge was a key requirement, as in programming, accountancy, estimating, and tendering.

The general impression of both home-based work and disabled people's employment is that they are inclined to be at the low end of the skills spectrum, so it is pleasing to have some evidence at hand which shows otherwise. It is very apparent that the vast bulk of jobs in Phase one fall within the medium and high level categories.

The first phase of the project has highlighted a gap in training provision to meet the needs of homebound people. So far, we have been able to identify two prime requirements: (1) basic skills training for people who have never had paid employment; and (2) more advanced training for those who want to build on existing skills. Some of the answers may well lie in the self-teach approach, and there are distinct possibilities for computer-based training for any disabled person with a computer at home.

Most of the employees included in phase one have a mobility problem. When a disabled person has the choice of working from home or going out to work, I would always recommend going out – and I am sure you will agree that the advantages of social integration are very significant. But for those with a severe mobility problem, the option of going out to work usually does not exist. Their choice is between staying at home unemployed or staying at home and working.

Twenty-four different types of disability were included – from those present at birth such as spina bifida and cerebral palsy, to those which developed in later life, multiple sclerosis and rheumatoid arthritis and of course quadreplegia and tetraplegia caused through accident or illness.

Several employees have indicated that working in this project has made them feel better in a number of ways. In particular, it has helped to restore self-esteem. They benefit from being regarded as worthwhile and productive employees, and from the financial independence the jobs bring. Working, they say, has also helped to overcome pain. No one has so far said that working has adversely affected their health.

I have so far concentrated on describing some of the "people" aspects, and would now move on to say something about the jobs being done. A list of sample jobs shows that they are quite varied. Rodney is self-employed. He was paralysed several years ago in a road accident, which left him with very limited arm and shoulder movement and in a wheelchair. At the time of his accident he was employed as a qualified accountant. With the microcomputer and range of accountancy software supplied by the project, Rodney is now able to offer a full range of services. This combined with his very specialised knowledge of accounting, and his skills in marketing have led to great success. He began eighteen months ago with three clients; within a year he had doubled that number; and recently he has employed someone else to cope with the extra work and bought a second microcomputer.

The equipment provided by the project usually consists of a standard business microcomputer: a screen, keyboard, and central processing unit.

Here are some of the other people set up to work from home: Jean works for a London mailing company entering all the regular transactions on the company's mailing list. She has very severe arthritis. Karen has spina bifida, and does word processing. John has multiple sclerosis. He works from his home in Kent for the London Electricity Board, producing management statistics in graphical form – bar charts, graphs, pie diagrams, etc. The message I want to leave with these examples is that the concept of remote working involving the use of Information Technology is a viable one for disabled people. The jobs bring satisfaction and rewards to employers and disabled employees alike.

Forty further units are currently being set up under phase two of the project. The procedure followed in setting up a unit is standard.

(1) The company provides the job, including the salary and running costs, like telephone charges, equipment, insurance and maintenance, and of course, the all-important effort to make it work.

(2) The project team provides help in defining the job, in recruitment, and gives support to get the operation up and running. The equipment is free on the understanding that a homebased, disabled employee will be using it.

The company gets a productive worker, and the disabled person gets an opportunity – and it is not an exaggeration to say a once in a lifetime opportunity – to enter the employment market. This project is clearly showing that the combination of Information Technology and remote working can provide real jobs for disabled people.

Actions taken in Colombia for the promotion and implementation of the International Classification of Impairments, Disabilities, and Handicaps

V. M. Townsend, and S. Kamper, Bogotá (Colombia)

– Brief summary –

An overview was given of the efforts undertaken in Colombia towards implementation and adoption of the International Classification of Impairments, Disabilities, and Handicaps published by the World Health Organization in 1980. A Spanish language version of the Classification system had been prepared by the Instituto Nacional de Servicios Sociales INSERSO, of Spain, and commented on by members of the Fundación Pro Rehabilitación del Minusválido.

An introductory seminar for Hispano-American countries was held in Madrid in 1981, at which Colombia was represented. Further impetus came through a visit of Professor Kurt Jochheim who gave two seminars to work out specific actions for promotion, diffusion and implementation of the classification system.

The main application of the classification system was seen in service planning and in the professional training sectors involving the faculties of medicine, nursing schools, occupational and physical therapies, language therapy, and social work.

The interest in the classification system in Colombia coincided with the 1981 creation of the National System of Rehabilitation to be in charge of coordination of services; revision and enforcement of legislation; preventive measures; and promotion of research. Obviously, an instrument such as the classification system intended to overcome confusion of terms and to assist in creating clearly established criteria for diagnosis and planning as well as evaluation in rehabilitation, was seen as potentially very helpful for the newly created National System.

Promotion and implementation of the classification system was undertaken on a local and national level through seminars and presentations at congresses. Intensive work with the system made the users aware of inadequacies, such as its inordinate length and its heavy medical orientation, which neglects the psychosocial areas.

Colombia is considered a pilot country in South America for the application of the classification system by the Pan American Health Organizsation. Thus, past and ongoing efforts are of importance not only in Colombia but also on an international level.

Second Plenary Session

– Tuesday, 19th November 1985 –

"Assessment/classification, evaluation of pain and anxiety, rehabilitation research and social policy"

Chair: Prof. J. S. G. Miller, Newcastle upon Tyne, United Kingdom

Fitness for work: Medicolegal assessment of residual disability and employment handicap

P. Cornes, Edinburgh, and H. M. Bochel, Canterbury (United Kingdom)

1. Introduction

During the past three years, in collaboration with a leading company in the British accident insurance market, the authors have studied disability management and rehabilitation practices in the context of personal injury claims litigation. Previous reports on this research (Cornes & Bochel, 1985; Cornes et al., 1985) have presented results for a sample of 209 personal injury claimants who were injured in accidents at work and who sought compensation under employers' liability policies. This paper is an interim report on a comparable sample of 485 victims of road traffic accidents who made third party claims against policy holders insured by the company which collaborated with the research. It therefore enables comparisons to be made between employers' liability and motor claimants. It also presents an opportunity to review some of the perceived implications of both studies for current approaches to the rehabilitation and resettlement of personal injury claimants with particular reference to the assessment of "fitness for work" in medicolegal contexts.

2. Materials, aims and methods

For the research, access was granted to all employers' liability files on cases settled over a two year period from early 1981 onwards in which damages paid to claimants amounted to £ 5,000 or more, and (as part of a wider review of approximately 1,400 motor claims) to all third party motor claims settled for similar amounts during 1982 and 1983 in which claimants were in employment when they were injured. At the time, the lower (£ 5,000) limit tended to mark the boundary between small claims, usually of short duration and with no permanent disability resulting, and those cases with longer timescales, usually involving several months absence from work, in which injuries or impairments often resulted in permanent disablement. Employers' liability settlements ranged from £ 5,000 to £ 60,000 with a mean of £ 12,926 and a median of £ 7,999. Motor claims settlements ranged from £ 5,000 to £ 305,000, with a mean of £ 17,923 and a median of £ 10,000.

Research objectives and procedures were the same for both studies. The main aims were

(1) to describe claimants from relevant socio-economic, clinical and occupational perspectives;

(2) to record their return to work;

(3) to trace their involvement with rehabilitation and resettlement services; and

(4) to examine medical opinion on their residual disabilities, anticipated employment handicap and, hence, 'fitness for work'.

The first two objectives were achieved by undertaking a comprehensive audit of all files to obtain relevant data. These were recorded on a pre-coded, computer-compatible schedule. Validation included independent checks on the interpretation of clinical data by a doctor who was not associated with the research team. The other research objectives were achieved by content analysis of the medicolegal reports contained in a 50 % random sample of the employers' liability claims files, and a 20 % random sample of the motor claims files. Analysis confirmed that there were no statistically significant differences between these two subsamples and the remainder of the populations of claimants from which they were drawn on 15 socio-economic, clinical, occupational and procedural variables on which representativeness was tested.

Content analysis of medical consultants' observations on, *inter alia*, residual disability and potential employment handicap was undertaken in two stages. Firstly, by expressing the number of words devoted to each theme as a percentage of total reporting on each claimant, it was possible to obtain a broad indication of the proportionate coverage of each theme, both for individuals and, when averaged out, for the sample as a whole. Secondly, by tape-recording, transcribing and subdividing observations on each theme into clusters dealing with common subject matter (noting the number of items comprising each cluster and the number of sample members to whom they applied), it was possible to construct tabulations of such observations in which selection of illustrative items was weighted by the relative frequency with which each cluster received attention in reporting on each sample as a whole. (For a more detailed account of this procedure, see Cornes & Bochel, 1984).

3. Results

3.1 Claimants' age, sex, and occupations

Table 1 shows that, despite slight tendencies for road traffic accident victims to cluster in younger age groups and for employers' liability claimants to cluster in older groups, both samples are quite evenly spread throughout the age range. The underlying similarity is confirmed by other data, revealing mean ages of 35 years (σ 14.1) for motor claimants and 38 years (σ 13.8) for those who were injured at work.

Table 1: *Age*

Age Group	Motor	Employers' Liability
Up to 20	21	16
21 – 30	24	16
31 – 40	20	21
41 – 50	16	23
51 and over	18	24
Total (%)	99	100
Number	475	209

There is a more pronounced imbalance between the two sexes (Table 2). Although males outnumber females in both samples, it is apparent that they are much more likely to be victims of serious accidents at work, where they comprise 93 % of the sample, than on the roads, where they represent 74 % of all victims. This difference, of course, is attributable to various factors including, for example, different rates for males and females of labour market participation, vehicle ownership, and exposure to road traffic hazards.

Table 2: *Sex*

Sex	Motor	Employers' Liability
Female	26	7
Male	74	93
Total (%)	100	100
Number	475	209

However, again especially where employers' liability claimants are concerned, it may also be attributable to the type of work undertaken. Table 3 shows that 91 % of those injured at work were in manual occupations, with 9 % in non-manual work, including only 1 % who were employed in a professional or managerial capacity. In contrast, 40 % of motor claimants were in non-manual occupations, including 9 % who worked in a professional or managerial capacity, leaving 60 % who were employed in manual work of different kinds.

Table 3: *Occupational skill level*

Occupation	Motor	Employers' Liability
Professional/managerial	9	1
Other non-manual	31	8
Skilled manual	36	46
Semi-skilled manual	14	13
Unskilled manual	10	32
Total (%)	100	100
Number	475	209

3.2 Claimants' accidents and impairments

The most common types of accident experienced by employers' liability claimants were being struck by an object (27 %), getting caught in an object (24 %) or falls (21 %). The majority of motor claimants were injured when travelling in cars (43 %), on motorcycles (25 %) or as pedestrians (14 %).

The main impairments resulting from these accidents are shown in Table 4. For employers' liability claimants, the most frequently occurring impairments were fractures (38 %), sprains and strains, mostly back injuries (18 %) and traumatic amputations (14 %). For motor claimants, apart from the 14 % who received fatal injuries, the most frequently occurring impairments were fractures (50 %) and concussion, often associated with skull fracture and facial or brain injury (15 %). These differences are reflected in other data on the bodily location of main impairments (Table 5). Whereas employers' liability claimants tended more often to receive injuries to the upper limbs (29 %), lower limbs (27 %) or neck and spine (21 %), motor claimants' injuries were predominantly to lower limbs (40 %) or the head (22 %).

Table 4: *Main impairments*

Type of impairment	Motor	Employers' Liability
Traumatic amputation	1	14
Fracture	50	38
Dislocation	2	3
Concussion/internal	15	3
Lacerations	6	8
Contusions	0.3	3
Sprains/strains	8	18
Burns	0	3
Psychological	0.7	0
Other impairments	3	5
Fatal	14	5
Total (%)	100	100
Number	475	209

Table 5: *Location of main injury or impairment*

Location of impairment	Motor	Employers' Liability
Head	22	12
Neck/spine	10	21
Trunk/internal	5	6
Upper limb	9	29
Lower limb	40	27
Fatal	14	5
Total (%)	100	100
Number	475	209

The number of significant injuries received by the two groups is summarised in Table 6. In contrast with employers' liability claimants, three quarters of whom (77 %) suffered a single injury, an equivalent proportion of motor claimants (76 %) suffered two or more significant injuries. Moreover, motor claimants were much more likely to be more severely injured (Table 7). Abbreviated Injury Scale ratings of injuries revealed that, while similarly small proportions of the injuries received by the two groups were of a minor nature, employers' liability claimants were twice as likely to suffer moderately severe injuries, and motor claimants were twice as likely to receive injuries of a severe, serious, critical, or fatal nature.

3.3 Timescales of medical treatment und settlement

Table 8 reports the median length of medical treatment and the median time from accident to settlement for both groups of claimants. Somewhat surprisingly, given differences between them as regards the number and severity of injuries, the median intervals between accident and discharge from medical treatment are of similar duration. Nevertheless, the median intervals between accident and settlement suggest that motor claims generally take a little longer to conclude. Common to both groups, however, is a quite noticeable period of approximately two years between cessation of medical treatment and settlement of claims.

Table 6: *Number of injuries or impairments*

Number of injuries	Motor	Employers' Liability
One	24	77
Two	29	11
Three or more	33	7
Fatal	14	5
Total (%)	100	100
Number	475	209

Table 7: *Severity of main injury or impairment*

Severity of injury	Motor	Employers' Liability
Minor	11	13
Moderate	24	59
Severe	44	22
Serious/critical	7	1
Fatal	14	5
Total (%)	100	100
Number	475	209

Table 8: *Length of medical treatment and time from accident to settlement*

	Median time (months)	
Timescale	Motor	Employers' Liability
Medical treatment	7	7
Accident to settlement	33	29

3.4 Return to work

During this period, approximately half (52 %) of the employers' liability claimants and three quarters (74 %) of the motor claimants returned to work (Table 9). Further small proportions of both samples were out of the labour market either permanently, through normal retirement or early retiral on medical grounds, or temporarily, because they were still receiving medical treatment for their injuries or for some subsequent ill health. The remaining 40 % of employers' liability claimants and (approximately) 20 % of motor claimants were those who, while fit for work, were unemployed. These latter groups included those who had returned to work only to be made redundant; those who had returned to work, possibly prematurely, only to discover that they were not yet capable of doing all that was required of them; and those who, having lost their jobs, had made repeated but unsuccessful efforts to find alternative employment. However, they also included the relatively small proportions of all claimants (13 % of the employers' liability claims sample and less than 5 % of the motor claims sample) in whose cases there was some suspicion of poor motivation, malingering or functional overlay.

Table 9: *Return to work*

Outcome	Motor	Employers' Liability
Retired	4	3
Still receiving medical treatment for injury or subsequent illness	22	5
Fit for work but unemployed		40
Returned to work	74	52
Total (%)	100	100
Base	413	200
Fatal cases	62	9
Total numbers	475	209

3.5 Residual disability

Content analysis of the medicolegal reporting on representative subsamples of the two claimant populations showed that, on average, almost a tenth (8 %) of the total content of reports was addressed to residual disablement. The medical consultants who prepared these reports anticipated no residual disability in only 1 in 20 cases, with some (mostly permanent) residual disablement expected in approximately 70 % of all cases, and with considerable residual disability predicted for the remaining quarter.

More detailed analysis of their opinion revealed two main features of this aspect of medicolegal reporting. Firstly, while it is possible to cluster observations on residual disability into general categories of severity, the content of most medical reports laid much more stress on the expected permanence of disability than on its severity. Secondly, the majority of references to severity of disability did not express the degree of functional loss anticipated in a standardised form. It was much more common for examination findings to be expressed in such general terms as „the usual limitations of inversion/eversion of the foot“ or „impaired manual dexterity“, when such observations might have been stated more precisely, or even quantified, making it much easier to assess the probable effect of disablement on resumption of normal activities.

3.6 Employment handicap

Medical advice on anticipated occupational handicap was subjected to similar scrutiny (Table 10). This revealed that employment handicap was mentioned less frequently, and that coverage of this topic was less extensive, with less than 5 %, on average, of reporting on each case devoted to it. It also revealed a predilection for general recommendations for lighter and/or sedentary occupations to cater to claimants' reduced work capacity. Four out of five recommendations on employers' liability claimants were of this kind, leaving approximately one in 20 cases in which doctors were of the opinion that claimants would never again be employable under competitive conditions, and approximately one in 10 cases in which no occupational handicap was expected. However, it is noteworthy that content analysis failed to bring to light a single example to suggest that consideration had been given to job re-design, the adaptation of equipment or premises, or the provision of aids to employment. While not applicable to every case, a more constructive approach exploring these options might have enabled more patients to return to work or, in some cases, to do so sooner.

Table 10: *Medical advice on occupational handicap*

1. Patient unlikely to work again (3 %)

a He will never again resume any remunerative employment, and he will always have to accept a protective attitude towards his left leg, as any further trauma could have serious consequences, perhaps even resulting in amputation.

2. Functional limitations make work difficult for the patient (55 %)

a He has returned to work as a machine operator, but his firm have been most understanding in providing him with work that it is possible for him to carry out using one good hand and one severely damaged hand. He has been employed on a number of machines all of which can be fairly simply operated and these activities he has managed to carry out satisfactorily. He had lost no time from work since his return and only fell down on one job which required him to operate a spring-loaded release with the damaged hand and this he felt unable to do, though he himself believes that activity in the hand is slowly increasing and that he might even manage this kind of machine in future.

b If (the patient) can find a job that he can manage with essentially one hand with occasional support from his left hand then this would be ideal, but again, in this economic climate this is going to be difficult to achieve.

c He says that with his work as a joiner he is unable to make much use of the contact lens because the period of wearing is then reduced due to the dusty atmosphere, and so he has to perform work without the contact lens and so is a one-eyed person.

d He is not fit to return to his pre-traumatic occupation as a roof sheeter on account of his back condition but is fit for lighter work not involving repetitive awkward bending, heavy lifting, climbing ladders or working at heights.

e He is unable to crouch and therefore has some difficulty in working at floor level. However, he can kneel to compensate for that.

3. Patient requires lighter or sedentary work (27 %)

a He is obviously not fit for a job as a labourer. The kind of work he could do is a job where he would have a chance to sit down from time to time, though it need not be fully sedentary. Lifting, walking, over-rough work and climbing are undesirable.

b In my opinion it is improbable that he will be able to return to the driving of heavy vehicles but I consider that he should be quite capable of working at a bench in a factory and it would not need to be a sedentary job.

c All this has made employment for her somewhat difficult, but a light job in which she could change positions frequently and in which she would not have to do any heavy lifting should be possible for her.

4. Patient will experience difficulty in obtaining similar employment elsewhere (8 %)

a It is possible that the grip of the left hand and the mobility of the left wrist will never return to normal as a result of this accident. This may well cause difficulties for the patient should he have to find alternative work, and this has become a possibility during the present industrial recession.

5. No occupational handicap anticipated (7 %)

a I am surprised that after an interval of nearly 18 months (the patient) has been unable to return to work. I feel certain that he is capable of returning to work as a driver. I believe with a little effort on his part he should be capable of undertaking some lifting duties.

Base: 199 observations on 77 cases.

A third feature of medical advice on occupational handicap was its generally prohibitive tone. „Lifting, walking, over-rough work and climbing are undesirable“ was fairly typical of such advice. Obviously, a patient who is counselled to avoid lifting weights heavier than a specified amount, or to avoid jobs which entail standing longer than a specified period will have a wider range of jobs to consider than one who is advised simply to avoid lifting or standing. But more refined advice presupposes a formal assessment of residual abilities when, as noted, such assessments were not an integral feature of current medicolegal reporting procedures. More refined advice also presupposes knowledge of patients' jobs and working conditions. However, relevant occupational data were not always provided. As many as a fifth of consultants' reports did not mention claimants' job titles, and fewer than one in five provided any information about claimants' employment histories or working conditions.

3.7 Referral to vocational rehabilitation

In view of the severity of claimants' injuries, the time spent away from work, the relatively high proportions who lost their jobs, and the extent of residual disablement and anticipated employment handicap, it might be expected that, in many cases, referral to vocational rehabilitation services would have been appropriate – especially given the time that elapsed between discharge from medical treatment and settlement. But, as Table 11 reveals, such referrals were quite infrequent. For example, although 40 % of employers' liability claimants were unemployed at settlement, only a small proportion were referred for vocational rehabilitation and resettlement, nine to various facilities or services provided by the Manpower Services Commission, and one to diversionary work in an industrial therapy unit, with an even smaller proportion of motor claimants referred. Moreover, examination of decision making in the small number of cases who were referred to vocational rehabilitation revealed that all such referrals were made at a very late stage of recovery, often several years after their accidents. It would seem that many more claimants might have benefitted not just from earlier referral to relevant vocational rehabilitation services but also from the more specialised advice or assistance they could have given with occupational assessment, vocational guidance, retraining or help in finding alternative employment.

Table 11: *Referral to rehabilitation and resettlement services*

	Percentage referrals	
Service	Motor	Employers' Liability
Medical rehabilitation	3	3
Industrial therapy	1	1
Employment rehabilitation	3	4
DRO service (placement)	1	4
Other (retraining)	1	1
Base	413	200
Fatal cases	62	9
Total number	475	209

4. Discussion

Our studies of personal injury claimants have revealed a marked difference between the time required for medical treatment and the time taken to settle compensation claims. Although some time is needed on completion of medical treatment to allow disabilities to stabilise and for other medicolegal formalities, this interval should have presented an ideal opportunity to refer claimants to appropriate rehabilitation and resettlement service – especially in view of the evidence that so many clearly did not regard their involvement in litigation as an impediment to return to work, or attempting to do so. There can be little doubt that such referral could have been particularly beneficial to those who were unable to resume their former occupation, or who had lost their jobs, or who were advised to find less physically demanding alternative employment. However, it was found that very few cases were referred to vocational rehabilitation when many more might have benefitted, and also that referrals were made at a later stage of recovery rather than earlier, contravening the now widely recognised rehabilitative principle of early intervention (Jarvikoski, 1980; Galvin, 1983).

It was also found that medical consultants were the main, and often the only, providers of occupational assessment and advice or guidance on return to work. Examination of their contributions to this essentially non-clinical aspect of medical practice, however, suggested some potentially serious shortcomings. For example, relevant occupational information is frequently incomplete or missing."Fitness for work" assessments therefore can be undertaken without detailed knowledge of patients' jobs or working conditions, and also without exploring the potential of job re-design, aids to employment or other adaptations or accommodations to assist return to work. Moreover, advice on restricted activities is seldom based on formal assessment and tends to have an overly prohibitive tone, and guidance on suitable employment is dominated by very general recommendations to seek lighter and/or sedentary work. Such guidance does not suggest that they are keeping fully in touch with changing labour market conditions, in which traditional forms of employment, including many unskilled manual occupations, are being transformed by automation and the other technolgical innovations now to be found in most work settings. In encouraging medical consultants to view vocational rehabilitation as an integral feature of clinical case management, the present medicolegal system may place an unreasonable burden on them. It may also be unfair to many of their patients, especially those with moderate or more severe injuries, in depriving them of access to other sources of expertise that could help with their vocational rehabilitation.

In Great Britain, medical consultants have been encouraged to assume overall responsibility for patients' rehabilitation and return to work as an integral aspect of clinical case management (e. g. Mair Committee, 1972). Indeed, this approach (and the sequential model of disability management on which it is based) have been found to be effective in the majority of cases with relatively minor impairments and short timescales, in which (normally) referral to other more specialised services is unnecessary. Other, more severely disabled patients, like personal injury claimants studied here, though, may have needs that are not met adequately by this approach because medical, social and occupational problems tend not to be addressed concurrently; because referrals to specialised services tend to be made much too late, if at all; and because timescales are determined more by patients' involvement in litigation and other medicolegal formalities than by rehabilitation requirements. At a more general level, therefore, our studies would seem to suggest that personal injury claimants who return to work before settlement of their claims do so despite the existence of an adversary climate and a medicolegal system that are not wholly conducive to vocational rehabilitation and resettlement. Iatrogenic factors would appear to be a more powerful deterrent to this process than is normally recognised. It follows that any attempt to enhance the effectiveness of the present system should pay at least as much attention to the influence on outcome of established professional practices and procedures in medicine, law and insurance as to the putative psychological explanations that have tended to dominate previous thinking on this subject.

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Systematic information within the European Community's action programme on disabled people

P. Daunt, Brussels (Commission of the European Communities)

I. Introduction

(1) Multidisciplinarity is an aspect of *continuity*, which is one of the foundations of this conference; another aspect of continuity is the coherence of different elements in a programme of action. It is for that reason that, before I speak of the European Commission's endeavour to promote systematic information in the field of disability, I propose to present a sketch of the whole activity in favour of disabled people in which the European Community is engaged and of which that specific endeavour forms one component. This preface will be brief, but I hope it will reveal the structure.

II. The context of action

(2) The total activity comprehends five interdependent actions, concerned respectively with financial intervention, concerted research, policy development, the promotion of innovation and exchange, and, finally, the information project which is the main topic of this address.

(3) The *financial action* is centred of course on the two thousand million ECUs which the European Social Fund contributes each year to vocational training and job adaptation, nearly 9 % of which in 1982 was devoted to projects for disabled people. Since then, under the new regulations but partly because integration can entail the drop-out of disabled trainees not from the programmes but from the statistics, this percentage appears to have declined.

The disabled are still a named priority category of workers for the Fund, with a new stress on young people, on new technologies, on innovation in general and on evaluation. A 'square deal' for the disabled in the Fund of the future will depend both on the inventiveness of promoters and on the priority which national governments choose to give to this sector.

(4) The *research* component is the only one of the five which is not a part of the Community's Social Action Programme, though its frontier with social affairs is becoming increasingly open. For those who are not in touch with this work, which belongs in the Community's Medical Research Programme, I should like to take the liberty of stressing both its quality and its potential. Among the activities likely to be of greatest interest to the members of this conference are the network of registers of congenital impairments, and the projects concerned with the diagnosis and treatment of deafness in infancy and early childhood, with microtechnology and visual impairment under Professor Emiliani of Florence, and with the evaluation of technical devices for the paralysed led by Professor Pedotti of Milan.

(5) *Policy development* is, I suppose the flagship of this fleet. Next month the Commission will decide on the adoption of a Communication to the Council, incorporating a 'Draft Council Recommendation', on the Employment of Disabled People in the European Community. Since this will be the first instrument, in the proper sense, ever proposed by the Community in the disability field, to say that attending its outcome will be exciting is an understatement. Meanwhile, we are actively preparing two further European policy initiatives, one concerned with the environmental problems of disabled people (housing, that is to say, access and mobility) and the other with social security and other benefit systems.

(6) The fourth element, aiming to *promote innovation, the exchange of experience and the dissemination of good practice*, is naturally more diverse. It is here that we can place the unique activity of the Community Network of Rehabilitation Centres, comprising an inner network of thirty-one centres and an increasingly engaged outer network which will before long embrace all the Rehabilitation Centres in the Community. A second network consists of 16 District Projects, aimed to produce models of how a local community can upgrade its total response to the needs of disabled people by a new effort to mobilize local human and material resources. Both these networks produce newsletters which can be available to you if you do not already receive them. Unter this head too, I must mention the Commission's programme of innovatory projects to provide suitable housing in the open community for disabled people, and the annual programme of financial support to autonomous initiatives to promote European innovation and exchange, including – if I may be forgiven for inserting a 'Commercial' – this conference.

Finally, under this head, the Education Ministers in Council have invited the Commission, with the help of governmental experts, to produce for 1986 a report on the situation regarding the integration of disabled children in ordinary schools, and we can hope that the outcome will be agreement for an European Programme on integration and innovation in the educational field starting next year.

III. "Handynet"

(7) I do not apologize for this introduction to my main theme. Our belief is that an action programme needs a major (rather than a merely marginal) and systematic information element; equally we believe that any initiatives of information specialists, isolated from policy and the delivery of services, are futile. I appreciate that to speak of a 'system' of information may appear pretentious. I am convinced, however, that we must set ourselves long-term goals, and try to imagine the intersection, at European level, of needs and possibilities in the information field not over the next five years but – let us say – the next thirty.

(8) *'Handynet'* is the nick-name for the Commission's effort to meet, in the disability field, the surf of information technology which will overwhelm all those who do not face up to it. It is, quite simply, one single project to develop, gradually but without ever stopping, a system of information concerning disability questions throughout the European Community, using computer technology as its instrument, covering ultimately all the sectors, and accessible to researchers, administrators and professionals but also, and perhaps more rapidly than any of us expect, to individual disabled people and their families.

(9) I hope you will assent to the aim – those of you, that is, who do not relish the prospect of a future in which our televisions will only deliver to us the elaborations of soap operettists, meteorologists and pornographers. But of course we have to face intimidating problems – those, above all, of the establishment of priority contents and targets, of the identification of partners, and of finances. How are we trying to overcome these obstacles?

(10) I believe that many of you here already know that we have chosen *technical aids*, and in particular profiles of all the technical aids commercially or otherwise available in the European Community, as the first module of Handynet.

We have cleared the ground: that is, we have identified the needs and the active or potential partners, and have nearly – after unexpected delays, I have to confess – achieved a thesaurus in all the Community languages, based on the Nordic system.

(11) Now we have begun the operational pilot phase of this first module. Active preparation involves, first, the establishment of common record systems, which will have to incorporate

not only the strongly needed data on each available aid but also data concerning evaluation, achieved with the aid of the medical research project I have already mentioned. To achieve this we have tried to practice the principle of continuity between information initiatives and client-oriented services which I preached at the start of this address. Three centres, all of them already operating computerized information within the context of regular services to clients, whether professional or disabled, are responsible for creating this entirely new European harmony. I find it encouraging that – without, I promise you, any complicity – all of them are represented at this Conference: by a number of experts from the Lucas Stichting in Hoensbroek, Dr. Dolfuss from the Mulhouse Rehabilitation Centre, and Professor Pedotti from SIVA in Milano. Perhaps, at last, in Europe we are beginning to "get our act together".

(12) But these three centres must not and will not work alone: during the course of their contract they will call together representatives of other centres or associations in their own and other countries, chosen on the recommendation of the governmental representatives with whom we have regular contact, for discussions which will ensure that the record system of technical aids meets the needs and possibilities of all Member States. With this action launched, we shall set up early in 1986 a second contract to establish the essential technical compatibilities for the collection, storage and communication of complete data on technical aids throughout the Community. An ambitious aim, you might say: before I respond to that possible objection, let me describe a number of other Handynet initiatives.

(13) Technical aids have been chosen as the first module of Handynet for a number of reasons, above all because we are convinced that systematic information will make an essential and dynamic contribution to the improvement of what is at present a fragmented and inefficient market – from both the producers' and the consumers' point of view. But we are aware of a pressing need for other Handynet contents also. We have therefore commissioned three 'need and scope' studies, covering the areas of employment; education, training and rehabilitation; and housing and access. Undertaken by expert institutions or individuals in France, Germany and Denmark, two of these studies are now completed and one will be available early next year. What is already becoming clear is a priority need, not so much for bibliographies, as for directories of institutions, associations, centres and even individuals who are actively engaged in research, development, policy or service delivery in these fields. This would seem to be a requirement which, at European level, Handynet should be uniquely designed to meet.

(14) Let me return now to the fundamental question: even supposing Handynet is a good idea, how can the Commission make it work? In my reply I wish to avoid, if I can, arrogant or insensitive assumptions. I say this for the simple reason that, without the moral and professional support of those who are well represented at this Conference, Handynet will not work. Let me nonetheless plead these five points in favour of Handynet:

(a) I dare to assert that to reject the need and possibility of a computerized European Information System on disability questions, well established in the nineties though with further still to go, would be a colossal failure of imagination.

(b) We are therefore proposing radical objectives, but by gradualist means. Hannibal's elephants crossed the Rhône (if memory serves) pedetentim, feeling cautiously with their feet: however, they crossed it. The doors of Handynet are ever open – to governments, to centres which deliver services, to researchers, to disabled people and their associations or families. Very soon, those who can join actively will be able to do so, and those who wish, for the time being, only to enrol as 'privileged spectators' will be also welcome.

(c) All the national delegations of the formal Community Liason Group on Disability, representing the relevant Ministries of the Member States, have agreed to undertake a national responsibility of coordination in favour of the development of Handynet. I do not, let this be clear, mean by that that the governments have formally agreed to a full participation, with all that might imply for them in financial, political and administrative terms. I only mean that positive interest and goodwill is developing in the Ministries, and (so far at least) without any fundamental blocks.

(d) As we go on, we endeavour to discuss Handynet with all our networks of communication, including our 'Dialogue Group' of all the major non-governmental associations of and for disabled people which exist at European or International level. We believe that this open policy is a source of strength.

(e) Finally, it must not be forgotten that in developing Handynet, the Commission is directly responding to the explicit invitation of the Council of Ministers delivered in the December 1981 Resolution on the Social Integration of Disabled People.

IV. The future

(15) In January, with the support of the Belgian Red Cross, we shall mount in Brussels a plenary seminar during which we shall present to governmental representatives, members of associations of and for disabled people and experts the situation and future prospects of Handynet. In inviting your interest in this event, I cannot, I am afraid, offer an open invitation to participate. But I can offer to send the report of this seminar to any of you who asks for it. As I have said already, your active interest and support is crucial to us.

(16) Finally, the broader future, including the financial aspects. The Commission has invested some 400 000 ECUs in Handynet this year: you will say, 'far too much' or 'far too little' according to the normal variations of human response. My own view is that we shall need to increase that European contribution. Next year, we in the Commission will have to design a new total action programme for disabled people, to start in 1988. The development of Handynet must and shall be an important element of that proposal. I invite the members of this Conference to join us by putting their shoulders behind that wheel.

Towards a national action plan to meet the changing needs of the disabled & handicapped persons

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In Canada, as in many developed countries, the complexity and fragmentation of services for disabled persons has been a source of frustration and a concern to governments and consumers alike. One recent study of the Canadian system was entitled "A Hit or Miss Affair" (1), aptly summing up the situation. Another publication by a parliamentary committee, studying the problem, was entitled "Obstacles" (2), reflecting the negative impact of the system on the potential of disabled and handicapped citizens. In recent years, the escalating cost of social programmes has been a major concern in Canada and in many other developed countries. Expenditures on institutional care and disability pensions have been calculated to exceed 10 billion dollars in 1982 (3). The institutional care component has been projected to double by 2020 AD *without* allowing for inflation (4). In the United Kingdom, the Economist Intelligence Unit Limited (5) has described the whole system of benefits for people with disabilities as "so complex, that no one can work out just how much they are costing. A common conclusion from attempts to analyse the problem is that expenditures are enormous and increasing at a rate faster than that of the gross national product" (6).

In Canada, a Committee of the National Research Council was established in 1982 to study the problem and to make recommendations on research and development to meet the changing needs of disabled and handicapped Canadians. This paper reviews from a personal perspective the process followed by the Committee in its efforts to respond to this challenge.

The work began by defining development as "the application of existing knowledge" and research as "the acquisition of new knowledge". From the outset serious dissatisfaction was evident with the incorporation of existing knowledge into established social programmes to meet the changing needs of disabled people. It seemed logical to begin by examining this problem. Research studies on the success of social programmes revealed that, consistently, programmes based on vague goals, poor implementation guidelines and with no measurements of success tended to fail (7). Social programmes for disabled Canadians seemed to fit this description. There were no clearly defined goals, and success or failure was not being measured in some tangible fashion.

From the literature on the planning of social programmes (7), guidance was obtained in devising a suitable plan of action to meet the changing needs of disabled and handicapped Canadians. Two crucial elements of an effective strategy for social improvement were consistently identified as the need for clearly articulated goals, and a means of measuring progress towards their attainment.

Modern corporate planning principles are remarkably similar and, indeed, both corporate and social planning methodology seemed to bear a close resemblance to the clinical process used in developing a sound rehabilitation plan with a disabled person. To be successful, a rehabilitation plan should involve establishing both long and short term goals in accordance with the nature and definition of the problem and the desires and priorities of the individual. A time frame is set for the achievement of these goals. Next, programmes and strategies are devised and resources assigned to solve the problems. Progress towards short and long term goals is measured and reviewed regularly, involving sponsors, consumers and providers of service in this review and consultative process.

Drawing upon this knowledge, the Committee developed an action plan to improve the application of existing knowledge and help define research priorities for the future. The three stage framework of the plan consisted of:

(1) Development of long term goals, with a time frame for completion, objective documentation of the present situation, and listing of the principal participants.

(2) Development of procedures for measurement of progress towards goal attainment.

(3) Identification of strategies, programmes and resources required to achieve both long and short term goals.

As a first step, efforts were made to articulate national goals, designed to meet both the needs and desires of disabled people, and which could realistically be acceptable to governments who provide the resources and to those who provide the services.

In Canada, through the disabled advocacy movement, and the work of parliamentary and other committees, people with disabilities had become increasingly vocal with respect to what they want. Their message was clear – integration into the community was the single most important goal. They did not want to be warehoused in institutions. They did not wish to live in poverty on a disability pension. They desired the choice and equal opportunity of living and working in the community wherever possible. They wanted accessible housing, employment, public buildings, transportation, and recreation. Governments, on the other hand, were concerned to find ways to contain the escalating costs without adversely affecting the services which were available. The principal concern of those providing services seemed to lie in the fragmentation of responsibility, and the inefficiencies of the service delivery system.

Two goals were adopted, which the Committee believed could offer a sense of direction, a unifying framework for cooperative effort, and reconcile the seemingly incompatible needs and concerns of all three groups. The two goals adopted were:

(1) A reduction in the need for institutional care by 30 % by 1990;

(2) A reduction in the unemployment level among employable disabled people to the national average of unemployment by 1990.

These two goals were then analysed in accordance with the planning framework.

FIRST GOAL, Reduce the need for Institutional Care by 30 % by 1990

– Objective Assessment of Present State

Basic documentation of the present situation was obtained from the Canadian Hospital Association Directory of Long Term Care Facilities (8). From this the number of longterm beds was found to be 250 000, or 1 %, of the Canadian population. A recent study by the Task Force on the Allocation of Health Care Resources (4) revealed that if present trends continued, the number of such beds required for the elderly would double by the year 2020. The cost of operating these institutional care beds for the elderly was given as 6 billion dollars. This was found to be in reasonable agreement with an estimate of 8 billion dollars as the total cost of chronic institutional care for the same year (1981) (9). The Task Force viewed the rapidly escalating cost of institutional care in Canada as a crisis demanding immediate action. Despite this, no single agency could be identified which tracked national expenditures on chronic institutional care beds on an annual basis. Comparisons were provided in the Task Force Report of the rates of institutionalization of the elderly for the United Kingdom (5.0 %), the United States (5.3 %), Australia (5.9 %), and Canada (9.45 %). On the basis of this comparison, it was recommended that the rate of institutionalization of Canada's elderly population should be reduced from 9.45 % to 6 %, a target closely resembling the goal established by the Committee.

Other characteristics of the problem were important: the nature of the impairments, disabilities, and handicaps, which result in people requiring institutional care. No comprehensive data of this type was available, but one regional study revealed that approximately 45 % of the chronic institutional care beds were occupied by individuals disabled primarily by senile dementia (10). National data on the type of disability necessitating institutionalization together with data on the cost of care, was identified as a high priority by the Committee.

Another dimension of the problem was the extent to which institutionalization results because no other alternative is available or tried. In the regional study of chronic institutional care already referred to, only 5 % of individuals with senile dementia received any community support services prior to being placed in the institution. Such information suggested the obvious strategy of rehabilitation assessment and treatment and the provision of community support services as a routine measure prior to institutional admission.

– Monitoring Progress

In terms of monitoring progress towards the attainment of the first national goal, an annual tabulation of the numbers of people resident in chronic care institutions, including information on impairments and disabilities responsible, and the cost, was clearly essential and became one of the recommendations of the Committee.

– Major Participants

The major participants in such an action plan were identified as the federal and provincial governments, disabled people, service providers, voluntary agencies, and the academic community. Each has an important role to play, and national and provincial consultations involving these participants were perceived as an essential step in gaining support for, and cooperation in, this social programme.

– Strategies and Programmes

Some of the key strategies and programmes identified by the Committee included (11):

(1) The need to identify a lead agency at both the national and provincial level. This body would be responsible for promoting co-operation and co-ordination of effort among the various departments and groups involved, including the establishment of interdepartmental committees.

(2) Wider use of rehabilitation services prior to the admission to chronic care institutions.

(3) The development of community support and rehabilitation services to provide an alternative to institutional care.

(4) More emphasis on the prevention of disability.

(5) Increased support for rehabilitation research and development with special emphasis on studies to evaluate

- rehabilitation potential,
- outcome of existing programmes,
- economics and cost effectiveness,
- rehabilitation systems delivery process.

(6) An increase in the numbers of competent researchers in the field of disability and rehabilitation.

(7) Closer collaboration between universities and clinical and community services.

SECOND GOAL, reducing the unemployment rate to the national rate of unemployment by 1990

– Objective Documentation of the Present Situation

Foremost among the questions to be answered was the need for a reliable estimate of the unemployment rate among employable disabled persons. The Parliamentary Committee in 1981 described the situation as follows: "the rate of unemployment for employable disabled Canadians is extraordinarily and unacceptably high. The precise figure is difficult to determine, but a former Minister of National Health and Welfare, the Honourable Marc Lalonde, estimated this figure to be approximately 50 %. A recent publication of National Health & Welfare, stated that the figure was 80 % and the Coalition of Provincial Organizations of the Handicapped, suggested that it may range as high as 90 %" (12).

Recently, the Canadian Health and Disability Survey, 1983/4, has produced important new evidence (13). According to this study, there are estimated to be 2.488 million disabled people in Canada, aged 15 years and over. The unemployment rate for disabled people was found to be 12.7 % compared with 9.8 % for the non-disabled population. A much more significant figure, in my opinion, was the rate of participation in the labour force. This was 69.2 % for those without disability, but only 31.6 % for disabled people. To be unemployed for the purposes of this survey, a person had to be actively looking for, and available for work. In my experience many employable disabled persons have given up looking for work, and though employable, they show up among those listed as non-participants in the labour force.

For some 18 years, in Kingston, we have offered a vocational rehabilitation programme, combining comprehensive medical and vocational rehabilitation services to disabled people, who have been judged to be unemployable, but who want to work. These people, most often, have had multiple problems, including chronic mental illness, mental retardation and a wide range of physical disabilities (14). Consistently, over 50 % of these individuals have used these services to rehabilitate themselves to competitive employment. The cost of the programme for all participants has been shown to be recouped within 2 years from the reductions in pension payments and from income tax paid by the successful participants. Thereafter, society continues to benefit by a significant reduction in the cost of these social programmes. Unfortunately, very few cities have vocational services of this sort.

ISSUES

1.674 million disabled Canadians are not participating in the labour force. How many wish they were? How many would be willing to enter such a programme? How many could, with appropriate help, achieve competitive employment? These are important questions which must be answered. I believe, a very conservative figure would be that 25 % wish they were working, and if 50 % of those were successful, over 200 000 additional disabled people would be working. Not only would they benefit by having a higher standard of living and an increased sense of selfworth, but *society would also benefit by the reduction in disability pension payments, which I calculate would be in the order of 1.2 billion dollars annually.* While this problem requires further objective analysis, it is clear from this new evidence that the aim must be, not only to reduce the unemployment rate of disabled persons but also to reduce their non-participation rate in the work force.

A second important issue is the determination of eligibility for disability pensions. This is now the subject of an eight nation international study being conducted under the aegis of Rehabilitation International (15). Canada is one of the participants. The findings are awaited with great interest, and it is hoped that they will provide assistance in efforts to increase employability of disabled people.

A third important parameter requiring objective analysis is the pattern of disabilities and handicaps which result in unemployment. To date, no comprehensive study of the causes or cost of financial dependency in Canadian society has been found. The Committee has recommended that a high priority be attached to funding such research.

– Measures of Goal Attainment, No Suitable Measure are Currently Available

In the design of a comprehensive study of the causes and cost of financial dependency, a methodology should be chosen that will permit annual review and the opportunity to make interprovincial and, hopefully, international comparisons.

– Strategies, Programmes and Resources

The Committee has identified the need for:

(1) Single lead agency at both the federal and provincial level to assume overall responsibility for the planning and implementation of this action plan.

(2) More consistent use of medical and vocational rehabilitation services for assessment and rehabilitation prior to the granting of disability pensions.

(3) Closer collaboration between medical and vocational services.

(4) Increased emphasis on preventing unemployment due to disability.

(5) Increased emphasis on vocational rehabilitation research and development to include studies of

- evaluation of rehabilitation potential,
- outcome of vocational rehabilitation programmes,
- matching of job requirements with personal disability and ability profiles,
- the vocational rehabilitation service delivery process,
- economics and cost effectiveness of vocational rehabilitation programmes.

(6) Increased numbers of qualified researchers in the field of vocational rehabilitation.

(7) Closer collaboration between university departments and vocational rehabilitation services.

This action plan is still evolving. The Committee has now written two papers and is reassessing its position and developing plans for the next four years. It is hoped that this overview of the activities may elicit information about studies in other countries relevant to the problems which have been identified in Canada. It is quite clear that many other countries share the same difficulties that impede the search for a more humane, independent and integrated life style for disabled people in Canada. The search for more cost-effective ways of providing these services is also alive in many countries. Through international sharing of information on the problems and solutions, it is hoped that understanding and progress towards a better life for disabled people will be advanced.

It is clear that in the pursuit of this common purpose in our various countries, we need to follow a planning framework of the type presented here. Discussion of goals must surely be a priority in the International Rehabilitation Research Community. Where there is agreement on goals, surely the second priority must be to establish methods of measuring progress towards the attainment of these goals, which will permit international comparison. This could lead to the development of International Handicap Rates, which would permit international comparisons of the incidence of handicap and progress towards its alleviation. Such a means of measuring the effects of policies and programmes is crucial, if we are to learn from each others experience.

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New trends in the adjustment of disabled people to the marketplace: A United States perspective

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– *Abridged version* –

1. Overview

According to the 1980 census, 144.62 million Americans are working age (age 16–64; Bowe, 1983). Of this population, 8.5 %, i. e. 12.3 million persons, report one or more disabilities. These self-reported figures are considerably below those reported through the Social Security Administration (SSA) Surveys of Disability and Work (Burkhauser & Haverman, 1982). As far back as 1978, over 21 million persons of working age were counted as disabled on the basis of household interviews in which individuals were asked to classify themselves on the basis of extensiveness of impairment. Persons with disabilities in the SSA survey accounted for 16.85 % of the working age population for that year.

These variations may be due to subjective reporting factors, the known high correlation between poverty and disability in states with low per-capita income, particular geographic conditions, or service availability factors. What remains clear is the existance of an extensive national problem, the impact of which is distributed unevenly. Whatever the reasons for the discrepencies between the Census and the Social Security Administration's findings, the number of Americans with some degree of disability is large. For the SSA survey, over half of the respondents classified their disability as one which precluded the possibility of ever working regularly (these persons were listed for the survey purposes as severely disabled).

Some summary findings from the SSA survey were:

- Disability is more prevalent among women than among men.
- Women who classify themselves as severely disabled outnumber all other groups of persons with disabilities.
- Blacks and other non-whites are overrepresented.

- Unmarried persons are overrepresented, as are older persons and those with little formal education.

Persons reporting themselves as disabled (although not as severely disabled) in the Social Security Administration survey work full-time, part-time, and generally participate in the labor force in about the same proportions as those who are not disabled. Their earnings, however, are systematically lower than the earnings of their non-disabled counterparts. In addition to the discrepancy between the earnings of workers with mild disabilities and workers with no disabilities, there are large differences between non-disabled and severely disabled populations. During the 70s over 85 % of working age non-disabled persons worked full time, whereas only half of the severely disabled working-age population was employed full time. As with workers who are mildly disabled, significant differences appear in earnings. In addition, persons with disabilities work fewer hours per year, and persons with disabilities work at lower paying jobs than those who do not have disabilities; those with severe disabilities earn about one-third of the income of non-disabled persons.

Although wage income comprises about 90 % of the total for living units in which no persons with disabilities reside, wages contribute only about 60 % of the income of households in which persons with severe disabilities live. Perhaps more to the point, persons with severe disabilities have only a little over half of the income of persons with no disabilities, even when income transfers and other benefits comprise a substantial part of their incomes.

This demographic and household economic context for considering the general situation of persons with disabilities in the nation is incomplete. Younger persons, especially those with developmental disabilities, are not discussed (they comprise about 7 % of the disabled population; over 90 % of these persons have developmental disabilities). Nor has this discussion emphasized the serious problems facing workers who are older; the probability of severe disability climbs to .25 for the 55 years and older cohort.

These issues of personal economics, work and the marketplace – the extent of self-reported disability, and its effects upon work, the incentives for work, and the income of individuals and households – all have an effect upon the well-being, sense of self-worth, and values of individuals, households and families and on society' s responses to persons who work less, receive less income, and have more expenses than persons who are not disabled or whose disabilities may not be handicaps to employability.The concept of employability itself becomes complicating and elusive as local marketplace conditions, business cycles and the burst of new technology push aside older approaches to vocational opportunities and to vocational preparation of workers.

2. The federal government's role in rehabilitation

The traditional government approach to disability combines income support and labor supply side measures, which include both job training and rehabilitation. Until the 1970s these approaches constituted the major governmental rationale and interventions. During the last decade, a second approach developed, i. e. direct intervention into the market, the attempt to intervene directly into the creation of jobs for disabled and disadvantaged persons. During this period of direct job creation, a third approach by the government began to gather force: the use of the authority of the government to generate "equal access" to jobs, education, and mobility.

Traditional approaches for government assisting a person with disabilities (directly or indirectly through other agents, through benefits or through services) stems from the societal decision to (1) reduce costs to, or (2) share costs with, the person with disabilities.

Costs associated with the disablement include medical care, loss of earnings, special aids, equipment or appliances for daily living needs, and associated indirect psychological and social costs to the individual and the household which are associated with the impairment. The economic argument for intervention includes that of overcoming productivity losses through collective investments in helping individuals to attain or reattain some measure of productivity.

Decreasing costs associated with care-giving through investment (benefits or services) for increasing self-care or self-sufficiency are other economic rationales. The major non-economic rationale for the traditional approaches stems from humanitarian or equity principles. We are all at risk, and the major social risks of society should be shared by all. The corollary is that major income discrepancies should be diminished, especially those which are created through no fault of the individual or which reduce opportunity for full participation in socially valued areas of society.

Finally, neither private insurance markets nor the legal system can adequately overcome the cost reduction or cost sharing rationales of traditional approaches. Insurance markets are partial in eligibility and coverage. The legal system stresses liability and damages rather than social efficiency or social equity. Conflicts frequently develop between the objectives of reducing aggregate costs of disability through rehabilitation and training and providing awards in form or amount which may be disincentives to the worker and his family for reengaging in the work force.

Direct job creation includes subsidies to the employer or employee, subsidizing costs of workplace adaptation, other incentives to employers, and the provision of public employment. The basic rationale for job creation is to overcome the current disincentives for hiring handicapped persons. Minimum wage laws, concerns about increased unemployment, and workmen's compensation insurance costs, discrimination practices and other attitudinal barriers are examples of legal and institutional barriers which may be overcome by direct job creation.

Generating equal access is the third governmental rationale for increasing the potential for fuller participation by persons with disabilities in the mainstream of society. The change in government policy introduced by the Amendments to the Rehabilitation Act of 1973 were similar in concept to the civil rights provisions enacted earlier to generate equal access to citizens regardless of color. The rationale for the government's policy for handicapped persons was to provide them with a similar commitment to integrate such persons into an able-bodied society. One description of a work-disabled person is a person whose limitations lead to conditions imposed by an employer, which are not based upon considerations other than the potential employee's ability to perform on the job. This is a form of discrimination, and government steps in to reduce or eliminate this practice, however motivated. Advocates for this approach view this form of job impairment as more pervasive than physical accessibility barriers, and to break such discrimination patterns of long standing, is seen as a legitimate target for government intervention.

One of the two major programmatic changes instituted under the amendments to the Vocational Rehabilitation Act in 1973 (now reconstituted as The Rehabilitation Act of 1973) was the emphasis upon serving clients with what were termed severe handicaps. A severely handicapped person was defined under the Act as a person having "a severe physical or mental disability which seriously limits his functional capacities (mobility, communication, self-care, self-direction, work therapy, or work skills) in terms of employability." The second major programmatic change was the inclusion of independent living as an alternative goal for those persons "whose disabilities are so severe that they do not presently have the potential for employment but may benefit from vocational rehabilitation services which will enable them to live and function independently." Both of these programmatic changes reflected a desire of the Congress, driven by consumer and professional advocates, to give more priority among those eligible for services, to persons who may require more or more extensive services.

The federal government spends over $ 20 billion on disability and disability-related programs under Titles II, XVI, XVIII, and XIX of the Social Security Act, as well as through support for special education and some employment training programs. The traditional state-federal vocational rehabilitation program, with a 1984 federal authorization of just over one billion dollars, provides a small proportion of services and benefits in an expanding benefit/ service universe. This is reflected in the increasingly diverse funding base used by rehabilitation facilities to provide services and training to individuals.

3. New employment initiatives

The Departments of Education and Health and Human Services have initiated pilot supportive employment and supported employment programs. "Supportive employment" at a worksite ensures continued employment through short-term supports such as follow-up of a trainer, assistance to the work supervisor, environmental adaptations, and retraining of the worker, when necessary. "Supported employment" is a more permanent support for workers who are unlikely to earn at or much above the minimum wage and who, because of their disabilities, will require ongoing support, such as special supervision, training and transportation.

Supportive and supported employment programs rest on a different premise. Employer and other institutional constraints, including government programs, prevent the marketplace from accepting or absorbing workers who are perceived as unemployable or who are themselves fearful of not succeeding in finding and keeping work, and who run the risk of losing benefits if they venture into the labor market.

4. Work disincentives

Handicapped persons may hesitate to enter a vocational rehabilitation program if they are concerned that social security disability insurance (DI), supplemental security income (SSI), and/or Medicare or Medicaid may be terminated as a result of successful job placement. Both DI and SSI programs require virtual withdrawal from the labor force as a condition for receiving the benefits. Benefits for workers with low predisability wages may come close to wages for re-entry to a job, thereby creating a powerful disincentive to train or otherwise prepare for work.

5. Efficacy issues

The examples of work disincentives and newer support employment approaches are illustrative of some of the crosscurrents in the rehabilitation services structure of the United States. People with handicaps tend to be unemployed or underemployed. Most enter the work force at or below the minimum wage. Increasing pressure by advocacy groups, unionization, and general societal trends toward equal rights, access, and treatment push rehabilitation agencies in conflicting directions. Should rehabilitation agencies continue to provide gainful activity at less than full market wages for thousands of persons with handicaps who may not have other alternatives? Three quarters of the population of sheltered workshops (with a growth rate of about 20 000 over the last decade) are persons with mental handicaps, many of whom have left institutions, others of whom might otherwise be sitting at home. Community-based work activity centers and other sheltered facilities have proliferated (with funding from state and local public and private funds) in many instances because of strong pressures from consumer groups. Difficulties in assessing service appropriateness, accessibility, coordination, and continuity remain perplexing planning issues which reflect the lack of coherent national policies. To indict local groups of concerned officials, professionals, and other citizens for not maximizing employment or functional potentials of clients may be premature, if not misguided. Competitive employment programs can use models already in existance, like the successful Projects with Industry program of the Rehabilitation Service Administration or the Supported Work model described earlier. Some analysts have estimated that increasing all hourly wages to the statutory minimum rate would result in a substantial further reduction in handicapped employment, with the least productive workers being the most affected.

The beginning of new provisions for retaining benefits and opportunities for agency-industry partnerships could move incentives in the direction of more aggressive outside placement efforts. Agencies at the state level have begun to move toward each other to attempt cooperative approaches to a serious, growing problem. Each state agency is limited by law (and funds) to its own mandate but receives pressures to expand services. The special education agency relinquishes responsibility at young adulthood. The rehabilitation agency can provide only short-term assistance, the employment agency may require special technical assistance, as may the agency for persons with mental retardation or mental illness. System change for increasing competitive, supportive, and supported employment opportunities will probably begin to unfold at state levels before the federal government develops coherent and more comprehensive rehabilitation program and fiscal policies.

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